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APRIL, 1934

ANALYSIS OF THE INDIVIDUAL

A Symposium Edited by
DONALD G. PATERSON

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OCCUPATIONS
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Vocational Guidance Magazine

ANALYSIS OF THE INDIVIDUAL

Editorial Overview

DONALD G. PATERSON

THE NOC program includes the *analysis of the individual* as an essential element in the occupational adjustment of youth and adults. In keeping with this objective, this issue of *Occupations* is devoted to a series of twelve articles in which twelve psychologists attempt to portray, from one angle or another, the extent to which vocational psychology is now prepared to aid in this phase of the work.

In presenting these articles as a sort of symposium, it should be clearly understood that no attempt has been made to explore and exhibit a complete, systematic treatise on the present status of vocational psychology. Rather, the aim has been to persuade a group of busy, working psychologists to put down on paper some of the things they believe the busy, working counselor would like to know about present-day ways and means of analyzing the individual.

A glance at the table of contents reveals a rich variety of topics. In general, one might divide the subjects into two groups: those which deal with practical applications of psychological techniques in typical guidance situations and those which tend to emphasize the theoretical and scientific aspects of research methodology. In the long run, of course, improvement in practical applications depends upon progress in theoretical research. It is futile, however, to make such distinctions because the history of pure and applied science abundantly reveals the interdependence of theory and practice.

II

"The Major Strategy of Guidance" has been placed first, because it so clearly and forcefully challenges traditional mass education by pointing out that the philosophy of guidance must permeate the entire educational system if guidance techniques now available are to be put into effective operation. Thus, the ground having been cleared of opposition to the application of guidance techniques, Crawford ushers the reader behind the scenes and shows how the technicians are forging better measurement tools as research discloses the weaknesses of existing techniques. The reader who happens to have been over-sold on available psychological tests will certainly be shocked by Crawford's polemic. On the other hand, the reader who happens to be a confirmed skeptic in regard to this business of tests

and measurements will undoubtedly be elated. But both types of readers should re-read the last sentence of Crawford's second paragraph—*"Sound tests do exist and furnish valuable evidence, not otherwise obtainable, for guidance."*

The article by Toops presents a comprehensive state-wide guidance program. Visionary, impractical, and too idealistic? Yes, if one clings to the educational philosophy of "the good old days." No, if one closely follows the trends of today which will become the practice of tomorrow. And then O'Rourke moves us along from a state-wide program to a national program in which government, education, and industry collaborate in the development of selective techniques and standards. Here is one answer to the persistent demand that educators should get a better knowledge of the world of industry and that industrialists should seek a better understanding of education. In other words, cooperative research of this type will contribute importantly in the direction of mutual knowledge and understanding.

It is a natural transition to go from the individual profile charts contained in O'Rourke's article to the graphic profile charts presented by Trabue as a means of portraying the pattern of traits which characterizes successful workers in particular occupations. This by-product of the Minnesota Employment Stabilization Research Institute is no new discovery nor is it any novel device—it is our old friend the Vocational Psychograph as described by Hollingworth in his pioneer book on *Vocational Psychology* written in 1916. It is significant that this device is being used by the National Institute of Industrial Psychology in England as well as in the vocational guidance work being undertaken on the other side of the world in Australia. But the term, Occupational Ability Pattern, has caught the fancy of many people, and it is well to have the dangers of misuse pointed out by Hoppock in his engagingly critical manner.

The reader is now privileged to take a look or perchance to take another look at the promising though somewhat formidable device known as Strong's Vocational Interest Test. Those who are likely to become shell-shocked when placed in the vicinity of those dreaded coefficients of correlation are warned in advance. And those who have become habituated to such harmless things are also warned because, in addition to simple coefficients of correlation, one is brought face to face with multiple factor analysis which goes outside three-dimensional space and plunges into the realm of five-dimensional space. But survivors of these mathematical pitfalls will value the discussion because of the significant data regarding interests as measured by the Strong Test.

Since Strong's article includes an example of multiple factor analysis, the reader will be prepared for Thorndike's discussion of "Unity or Purity in Traits and Tests." The Committee on Unitary Traits, of which Thorndike is chairman, is carrying on fundamental research of great theoretical importance which may lead to revolutionary changes in the psychological tests and measurements of tomorrow. No counselor who is aware of these pioneering inquiries will dare become satisfied or completely dependent upon existing instruments of psychological diagnosis.

The articles by Kitson and Hull are designed to disclose the techniques involved in developing vocational aptitude tests. Here we see the elaborate methodology which should be employed in the development of vocational selection and vocational guidance tests.

And finally the articles by Earle and Alexander provide a close-up of British thought and action. Earle, formerly head of the vocational guidance work of the National Institute of Industrial Psychology, describes the significant elements involved in a psychological approach to the vital problem of diagnosing the individual. Alexander, on the other hand, surveys the field of psychological research in Great Britain and America. He attempts to synthesize various approaches, and finally formulates a comprehensive research program which, if carried out, would undoubtedly facilitate progress in the field of vocational guidance. Especially noteworthy is Alexander's insistence that the three aspects of guidance —individual analysis, occupational analysis, and guidance techniques—should be integrated in a unified approach employing the *same* set of terms. This thought-provoking survey and forward-looking plan of research action is placed last in the series of articles because it so adequately surveys the present and so sharply directs attention to the immediate future.

III

Progress in science does not come through censorship and forced regimentation of ideas. Hence, the "guest editor" of this issue has used no blue pencil in preparing these papers for the printer. Differences in point of view and even contradictory statements of fact are apparent in the several contributions. These are healthy signs of a lively interest, and of vigorous activity on the part of vocational psychologists.

Thus the working counselor on the firing line can be assured of increasing support by those whose business it is to provide some of the weapons of attack and to supplement these by increased knowledge of their possibilities and limitations.

DONALD G. PATERSON ("Analysis of the Individual") is Professor of Psychology, University of Minnesota, and Secretary of the American Psychological Association. He headed the work in Individual Analysis and Re-training done by the Minnesota Employment Stabilization Research Institute. He is author of *Physique and Intellect* and other books, and co-author of the widely used Pintner-Paterson Scale for measuring performance. Professor Paterson served as special editor of this issue of *Occupations, the Vocational Guidance Magazine,* and his efforts made possible the presentation of the articles included in it—a service, we believe, to all guidance workers. He is chairman of the Technical Committee of the National Occupational Conference.

ANALYSIS OF OCCUPATIONS

Under this general title a symposium edited by Morris S. Viteles will appear in the June issue of *Occupations, the Vocational Guidance Magazine.* This will be a companion issue to the present one on "Analysis of the Individual."

THE MAJOR STRATEGY OF GUIDANCE

BEN D. WOOD and F. S. BEERS

WHEN insulin was perfected, the discovery did not come like a bolt out of the blue. For years a great many facts had been established about the function of the tissues now known as the islets of Langerhans and about the function of certain other tissues known as acinar cells. But a great physiologist had with authority pronounced the islets to be merely exhausted cells of the acinar variety, whereas they are in reality highly important for sugar metabolism. Most research workers in physiology and medicine accepted the fiat; and it is probably fair to say that, in consequence, the discovery of insulin was retarded by at least twenty years.

A similar pathetic fallacy bids fair to prevail in the field of educational and vocational guidance. Counselors and experts in guidance have long known that vocational guidance is essentially educational guidance; and guidance along educational lines is seriously crippled if not actually helpless in the face of regimented and stereotyped curricula. What, for example, would have been the fate of the Wright brothers if they had been born 25 years later, had been collared by the truant officer, and had been forced to leave their bicycle shop for rigorous training in spelling, arithmetic, and community civics? It is hardly necessary to enlarge upon the implications.

The techniques of guidance have long been known to every experienced counselor. While they have by no means reached a state of perfection, they are nevertheless practical and highly valuable *if there is opportunity to apply them.* The most adequate description of these techniques is outlined in connection with the cumulative educational record form of the American Council on Education.[1] The educational record form is arranged to give a compact, sequential sketch of the pupil's school and social history for a six-year period. Three such forms would cover the elementary, high school, and college career of a boy or girl. When filled out, they present a time-projection of high points in the child's life. The most prominent feature of this record is its vertical columns which, from left to right, represent successive calendar years subdivided by light lines into calendar quarters. In the left margin are the rubrics, so that a given kind of information is always found on a given line; and the date of the observation, measurement, or event is indicated by the column in which it is recorded. Thus, it is possible to secure a bird's-eye view of the child's recorded life in any one year by reading the column for that year; and it is possible to follow the child's development by reading all the entries in a given line from left to right.

Essentially a graph, this form is convenient both for recording and for organizing and interpreting information from varied sources. But the record itself does not illustrate fully one type of

[1] *Educational Record Supplement (1928).* Copies may be secured from the American Council on Education, 744 Jackson Place, Washington, D. C.

information which the committee urged as necessary in its original report,[2] namely, the description of the child's conduct and personality by means of frequent brief reports from the teacher—concrete observations on the personal development of the pupil. In the few schools where guidance has become an art much time is given to observing the behavior of pupils; events are recorded in the form of anecdotes and are analyzed and interpreted periodically. This procedure is useful, along with the data from comparable achievement tests,[3] for long-term guidance where tentative goals are set up and are progressively modified.

II

Despite fairly scientific knowledge regarding the tools of guidance, counselors have failed dismally to reach their goals. They have laid themselves open unwittingly to the strictures brought down on their heads by the blunders of intemperate zealots. To an unthinkable degree guidance experts are so exclusively absorbed in the technical minutiae of their craft—in the refinement of tests, in the niceties of statistical analysis, in the fly-by-year interviews forced by circumstances—that they have ignored the fact that guidance lies at the very taproot of education, that perspective must be developed in the administrators and curriculum-makers who dominate our schools, that guidance is a philosophy not a dull bookkeeping. Not only must the administrator be induced to forget his notions about what the child *ought* to know, but the teacher must learn to place the welfare of the pupil above departmental loyalty. School objectives have no validity except as they are compatible with the needs of the child who must be rediscovered as an individual.

While the counselors are buried in technical detail, our teacher-training institutions continue to pour out administrators, curriculum-makers, and classroom tacticians. These graduates are zealous to administer, to make curricula and to teach, but oblivious to their highest duty of searching out and meeting the needs of growing children, whether they be geniuses, mediocrities, or morons. If the experience of the last decade has shown anything, it is this: Unless the great majority of teachers become guidance-minded, nothing can save us from our administrators and from our subject-matter-bound tacticians.

From the viewpoint both of society and of the individual it is obviously more important what kind of social being a pupil becomes than what prescribed courses he passes. Administrators have tried to attain "the objectives of the school" with mass prescriptions called curricula and standards, and by enforcing these prescriptions with all the direct and indirect means of coercion available within the law. The traditional apology for the *a priori* curriculum is that children must be socialized. But this defense has never clarified how the flunkers (10 to 40 per cent) are socialized, nor how the great majority of those who pass are socialized if they never have occasion in later life to use their gleanings from such courses.

Experience has shown that many of the prescribed courses are beyond the intellectual capacity of large fractions of the school population, alien to the interests of a larger fraction, and irrelevant to the

[2] *Educational Record Supplement* (1928). Pages 53-64.

[3] *Basic Considerations in Educational Testing.* By Ben D. Wood. With list of tests. Reprints on request to Committee on Educational Testing, University of Minnesota, Minneapolis, Minn.

life needs of a still larger fraction. Candor compels us to observe that, however valuable, not to say glorious, some subject matters have been and will continue to be, such subjects could hardly have survived as universal requirements except for departmental loyalties, highly organized academic log-rolling, and social inertia.

III

The foregoing facts and points of view have long been known to experts in guidance, and most counselors have long-standing sympathy for the dean of men who said to a student: "If you want an education you should take the program you have outlined; if you want a degree you must take these required courses, which are admittedly irrelevant to your purposes; but you cannot get both an education and a degree from this college." The dean had recognized the hopeless incompatibility of significant educational guidance as a philosophy and the humdrum digging that marks the pursuit of a degree.

Guidance is a philosophy! But it cannot realize its full potentialities until (1) a greater share of the educational budget is allotted to its functions, and (2) a majority of administrators and teachers acknowledge, with both mind and heart, that the welfare of the child is more important than departmental loyalty and curricular pattern. These two changes cannot be made by purely technical advances. The guidance leaders must turn their attention to the administrative, financial, teacher-training, and curriculum-making agencies in our schools, as well as continue their work of technical research and self-education. Self-education is essential, but insufficient. It is only too obvious that constructive, systematic, long-term guidance cannot become a reality unless active and hearty cooperation of the majority of school officers and teachers replaces their present attitude, which is frequently one of active opposition, and is almost never better than indifferent tolerance based on lack of understanding. In other words, one of the indispensable prerequisites to guidance potentialities is to convert Professor Morrison's exhortation into actuality: "Teachers (should) spend half their time studying their pupils as individuals, and the rest of their time doing what that study shows to be desirable and necessary."

This re-orientation of teachers and school officers cannot be accomplished by the teacher-training institutions alone, for at least two reasons. First, the majority of these institutions are themselves apparently committed to the prescriptive curriculum as an administrative and financial necessity, if not to a disciplinary and compulsive theory of education. Second, only a fraction of the teachers now in service can expose themselves to the direct influence of the teacher-training institutions. The immediate need, therefore, is the double one of discovering some effective way of re-orienting teachers in service, and of giving guidance a sound philosophical, administrative, and financial foundation in our teacher-training institutions. To be effective, guidance must become, at least in its fundamental philosophy and broad administrative implications, the corner-stone of the professional education of teachers rather than a technical specialty to which only a small fraction of teachers in training (prospective advisers, deans of students, etc.) are normally exposed. Orientation toward guidance as a philosophy must come from within; and if it is not encouraged by counselors and tech-

nicians themselves, hope must become progressively attenuated and tangential.

Broad curricular outlines and descriptions of desirable objectives have their value, of course, not as specific goals to be sought, or as standards to be enforced at any cost, but as general guides for the ultimate curriculum-maker, namely, the teacher who comes into daily contact with the individual pupil. In the ideal school curriculum-making will become a process of formulating individual goals and of modifying them progressively in accord with the developing capacities, interests, and needs of individual pupils. This process will be a continuous cycle of: (1) learning the capacities, interests, and needs of individual children; (2) setting up provisional goals, academic, vocational and professional; (3) getting the student to consider those goals at least provisionally; (4) helping the student to attain those goals by teaching when necessary, or by refraining from teaching when possible; (5) studying the progress made, with a readiness to modify the goals if necessary. The indispensable instrumentality for this process is the cumulative record of comparable measures, personal and social data, and teachers' observations, such as that recommended by the American Council on Education.

This new approach to the whole life and substance of education, this expansion of a technique into a philosophy, this rediscovery of the child as an individual is something to give one pause. And though the reluctance of the craftsmen to undertake the task is, perhaps, a real tribute to their modesty, failure to meet the obligation would be nothing short of genuine tragedy. It is not heartening to contemplate the magnitude of the undertaking, nor the travail of a revolution in educational thinking. But even more disheartening is the danger that in the future education may become still more acutely and still more ingloriously regimented.

IV

Modest though it may seem, one of the most hopeful, self-perpetuating attacks on the problem arises out of the individual case study.[4] Most teachers are genuinely interested in the children committed to their care; and most administrators likewise. What, then, could be more fitting than that the philosophy of guidance be brought home concretely to these teachers and administrators? A single case, well-selected and well-documented, is a more powerful instrument than volumes of the most recondite exposition, or the cold and lengthy eloquence of extensive investigation.

The simplest procedure is to select a child, any child, in whom some teacher has shown an interest, and then, in the absence of cumulative data, make a cross-section or horizontal study, using achievement tests, aptitude tests, and the like. A modest diagram may then be drawn in the form of a circle with radii sufficient in number to represent each variable. These radii may then be calibrated in percentile or sigma units and the child's scores plotted at the appropriate intervals. The points having been connected by lines, the resulting figure is almost certain to shed new light upon the child as an individual whose deviation from any standard or ideal is a fact to be faced educationally.

If in addition the counselor has available anecdotal material, such as referred to above, and various ratings such as those from Strong's Vocational Interest Blank, so much the better. It is but a

[4] *Vocational Counseling at the University of Minnesota.* By E. G. Williamson. Reprints on request.

single step from this point to direct questioning of the teacher—should all the machinery and impedimenta of education be brought to bear upon the child in an effort to iron out his deviations from the norm? Or, in some measure at least, should his outstanding traits be encouraged and his weaker ones ignored, or at any rate not dinned into his consciousness as shortcomings which must at any cost be brought up to scratch?

Individuation as an end in itself may, of course, be carried to an unfortunate extreme. And teachers or others may even entertain just doubts lest overemphasis lead to abuses and dissolution of social values. The philosophy of guidance, however, does not call for any surrender to the laziness or irresponsible whims of pupils. Its purpose is not to decrease the control of the child by the school, but rather to make that control more intelligent and more effective. When teachers waste less time on teaching and "class-keeping" rituals which are admittedly futile for large fractions of our school population, when they give more time to studying children as individuals, in the light of comprehensive, cumulative records that are systematically kept up to date, there is every reason to believe that school control will be both more effective and more constructive. When children begin to realize that their teachers are not merely policemen whose paramount duty is to "put over" prescribed courses which are irrelevant, or to enforce standards which are impossible, but are devoted to helping them become better and happier people by meeting their needs whatever their needs happen to be, there will be fewer temptations for children to develop protective coloring in the form of the many anti-social and negative attitudes and habits which now too frequently constitute the chief contribution of the school to its pupils. Unless the guidance and measurement movements help to bring about this change in the attitudes of both teachers and pupils, both movements will have failed in their first opportunity and basic obligation to society.

BEN D. WOOD ("The Major Strategy of Guidance") is Professor and Director of the Bureau of Collegiate Educational Research in Columbia College. He is the technical adviser to the Carnegie Foundation's Study of the Relations of Secondary and Higher Education in Pennsylvania, and is also Director of the Cooperative Test Service of the American Council on Education, and of the Educational Records Bureau. Dr. Wood is author of *Measurement in Higher Education* and of Volume I of the *Modern Foreign Language Study Reports*. He is in demand as a speaker at educational meetings, and for each of several years past has made two or three extended lecture tours of the whole country. He is active in various research organizations, such as the Personnel Research Federation, the National Vocational Guidance Association, the American Educational Research Association, and the Progressive Education Association. He is a member of the Technical Committee of NOC.

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WHAT ABOUT ALL THESE TESTS?

ALBERT B. CRAWFORD

WHAT is the practical value of the various types of tests developed in such profusion during the past decade? In general, what sort of tests are there and how much reliance can be placed upon them in the guidance of an individual's education or career?

So many different views exist on these questions, and so little demonstrable evidence fortifies the answers thereto, that criticism or interpretation of the test situation today is largely influenced by personal opinion or experience. The middle ground—of conviction that sound tests do exist and furnish valuable evidence, not otherwise obtainable, for guidance, but that they must be used with discrimination and a meticulous scientific probity—is probably the most reasonable to hold.

Nor is this statement a mere platitude. Its pertinence is attested on the one hand by the extreme distrust with which "psychological examinations" are regarded in some educational quarters; and, on the other, by the loose way in which tests have been widely adopted at various bureaus or institutions, without any real assurance of their suitability to the particular situation in which they are so confidently employed. Pessimists retard the development of tests by refusing even to experiment with them; uncritical optimists endanger their future standing and improvement by using them without sufficient caution.

II

The various types of psychological tests most largely used may be roughly classified in several ways according to their form, their content, or their purpose. Those of *character, personality, attitude,* or *interests* form one important group which is concerned with personal adjustment and reaction, rather than with capacity or learning. Strong's Vocational Interest Blank, for example, performs a useful purpose by suggesting the profession in which an individual may find himself most congenially located, and most stimulated by the nature of its activities. Yet it makes no pretense of measuring whether that individual has either the already achieved *ability* necessary to succeed therein, or the *aptitude,* or power to acquire that ability through proper study and training. "Personality" tests do not attempt to measure learning or skill—they are concerned instead with types of behavior, such as extroversion or introversion, ascendance or submission, reactions to other individuals or to social situations, and other largely non-academic adjustments.

This extensive group of personality or attitude tests, therefore, may be distinguished from other "psychological" examinations by reason of their different approach to analysis of the individual. Such devices, to be sure, have their scales and their norms, but they are not so much concerned as are aptitude and intelligence tests, with measuring the *amount* of individual achievement in some given direction. Their scales do not all run in a continuous series from worst to best, or from zero to perfection. One person for

example may score high on the aesthetic and low on the political scale of an "attitudes" test, or high in scientific and low in legal "interest" on the Strong Vocational Interest Blank; but there is no inherent quality of rightness or wrongness in such scores. They represent a sampling of individual tastes, opinions, or reactions. Clearly, personal variance in such matters is something of quite another order than are individual differences in adding a column of figures, in reading ability, or in the operation of an automobile. The personality measure is essentially *qualitative* in nature, where the other sort of test is *quantitative*.

Turning towards the latter type of examinations (which measure the degree to which individuals differ not in attitudes, but in possession of abilities definitely recognized as desirable) we find that these are tests primarily either of *achievement* or of *aptitude*. Both forms attempt to rank the individual, in relation to others, on some progressive scale of excellence. Practically all the tests of general intelligence, specific performance, trade abilities, skills, aptitudes, and achievement are directly or implicitly graded in terms of a "norm," or distribution of scores, among groups of people upon whom the measures have been "standardized."

An employment or trade test for prospective lathe operators is standardized upon actual lathe operators; one for prospective motormen upon motormen already in service. Past records of these employes determine the criteria for satisfactory, superior, or inferior performance. Similarly "intelligence norms" for high school or college students are determined by giving an intelligence test to many such individuals, and comparing the test ratings with their academic records. Aptitude tests likewise are tried out on prospective students or workers, and the relationship between their various scores made before special training or study, and their subsequent performance in the special field, are then analyzed. In this way a basis is developed for administering the same tests to other individuals and therefrom predicting in turn what *their* probable future performance in such work or educability for it may be.

Whether these measures which we have called essentially quantitative in nature fall into the achievement or the aptitude category depends largely upon their purpose—that is, whether their particular aim is to measure past (acquired) or future (to-be-developed) accomplishments. In both cases, some type of past experience is necessarily sampled. One cannot test pure future educability except in terms of something which the individual has already attempted. Aptitude for literary (verbal) studies can scarcely be measured in a child who is too young to read, or mechanical ingenuity in a subject wholly unfamiliar with a level or pulley. So tests of aptitude proceed either by the method of analogy, or by that of testing a form of learning necessarily antecedent to that required for the future accomplishment in question. But they differ nevertheless, according to whether they look primarily forward (toward what the individual is likely to learn) or backward (at his level of acquirement to date).

Thus study of the law involves (among other things) judgment in applying general rules to particular situations, analysis of complicated problems into their component "points" and the weighing of certain resulting arguments against others. It is possible to test the ability to perform these logical and analytical func-

tions without calling upon any actual knowledge of the law—but not without drawing upon sufficient previous training to ascertain whether prospective students possess these abilities in the abstract. A successful aptitude test reliably measures qualities essential in successful future performance, by sampling previously acquired skills associated or antecedent to those qualities, but without introducing elements which can only be acquired from the proposed future study. Such examinations attempt to forecast subsequent progress by evaluating its known precursors. The child is still father of the man. Achievement tests naturally hold significance for future developments because a student's accomplishments to date, whatever they may be, afford the most reasonable basis for estimating his subsequent progress along related paths. But aptitude tests must definitely go further, and attempt to predict what the individual may accomplish in the future if exposed to certain training *which he has not yet had*. Both types may differ widely among themselves in content, immediate objective, form, or level of difficulty. Thus an examination administered after appropriate training to stenographers or to taxi drivers is very different from an achievement test in modern languages or a College Board English paper, yet these all attempt to evaluate definite accomplishments. With aptitude tests again, we may find examples in both the vocational and the educational fields, quite unlike each other in subject matter, but with the same characteristic of seeking to measure *educability*, or specific learning capacity, rather than past acquirement, *per se*. Indeed both deal with the *capacity to learn* and whether we designate them as vocational or educational merely depends upon whether the prospective learning is usually obtained through occupational training or formal schooling.

III

Related to both phases of learning capacity but particularly so to academic aptitude, are the tests of "general intelligence" which, beginning with Binet's pioneer work, have contributed so vitally towards educational progress. Some of the most widely used, carefully prepared, and best standardized psychological examinations are of this type. Their usefulness for individual counseling, however, is now more and more being called into question. Although we may accept the existence of "general intelligence" (also variously referred to as IQ, academic aptitude, mental alertness, Spearman's "*g*," etc.) its nature and definition have never yet been agreed upon. Moreover, different individuals may produce essentially the same total score on such a test by quite different means. One person may range between the 40th and the 60th percentile on each section of the whole examination and be scored as average. Another may reach the same general level by scores of around the 15th percentile in an arithmetical subtest, and around the 90th in verbal items (such as synonyms, vocabulary and the like). Still another may just reverse the latter process. Variations of this nature and extent are not found, to be sure, with most people, but it is precisely when dealing with the unusual that one should be able to recognize it and to heed what Truman Kelley has called the "individual idiosyncrasy."

To illustrate further, an average school grade of 75 in English, history, mathematics and science means, for guidance purposes, one thing if it is composed of individual marks in these subjects, all

ranging from 70 to 80; and quite a different thing if the individual obtains marks of 55 in both English and history and of 95 in both science and mathematics. Each type of student makes a general average of 75, but educationally they are vastly different and require different handling and advice. The omnibus or "general intelligence" type of test, by the process of averaging scores on unlike mental problems, tends to obscure rather than to reveal those very differences which are most significant for individual guidance. In an exceedingly clear and able discussion of test construction and objectives, Lindquist and Anderson state: "A single score as a composite measure of a collection of specific achievements is meaningful only to the degree that these specific achievements are homogeneous and interrelated, and loses meaning in proportion to their heterogeneity. Highly diversified characteristics *must* be measured *separately*. For example, one would not attempt to express in terms of a single numerical measure a composite of the weight, color, and utility of a piece of furniture."[1] Brigham likewise, in *A Study of Error* says, "No one has ever demonstrated that it is legitimate to add such apparently heterogeneous performances as detecting absurdities, arranging a set of five weights differing by three, and copying a design from memory after a ten-second exposure —yet all standardized scales were based on the assumption that this very questionable procedure was legitimate. . . . The standardized scale draws attention to the total score on the scale. This total score, differently reached by different individuals, after transmutation into a mental age scale and division by chronological age becomes an end in itself. . . . We accumulate tables of total scores on untold numbers of children but advance not one step in the understanding of the essential nature of the separate problems. Standardization obscures further insight."[2]

Such realizations have lately changed the trend of intelligence testing from an attempt to measure mental alertness or ability in general, to emphasis upon more purely diagnostic tests of specific educational aptitudes. Brigham's work in developing the Scholastic Aptitude Test for the College Entrance Examination Board has been outstanding in this recent movement. He has clearly segregated the measurement of verbal and of mathematical abilities and has attempted as well to test the mental process—so important for engineering, architecture, and certain other studies or occupations—which is largely dependent upon an ability to deal with three-dimensional space relationships in a constructive and intelligent way.

Other tests aiming as these do, to measure students' potential ability in specific fields are being developed. In addition to those mentioned above, aptitudes for pure science (as distinguished from that for engineering) and for languages give promise of being measurable. The most hopeful future usefulness of tests for the purpose of educational guidance seems to be in the development of these tests of relatively specific and distinguishable aptitudes for one or another field of study.

It should be borne in mind that such aptitudes can be determined, if at all, only in respect to the particular situation toward which the individual is headed.

[1] Lindquist, E. F., and Anderson, H. R. "Achievement Tests in the Social Studies." *Educational Record*, Vol. XIV, No. 2, April, 1933, p. 239.

[2] Brigham, Carl C. *A Study of Error*. College Entrance Examination Board, 1932, pp. 23-24.

The level of attainment forecast for him must be expressed *in terms of the group with which he expects to compete.* The true significance of any such test—whether of aptitude for certain studies or for general academic promise—depends very largely upon how well it has been validated for the *specific* conditions towards which the prediction in question is directed. This means, in turn, that a test is of questionable prognosticating value for success in a given school or college or trade, until it has been satisfactorily standardized on the particular population (or some other of known comparability with it) whose ability, as a group, will set the standards of that success.

This must be emphasized particularly with reference to educational tests, of whatever nature. After all, the standards of satisfactory performance for a punch-press operator, or a short-order cook, or an accountant, or an actuary, or a railway engineer are pretty well established by employers, professional associations, or unions. Such standards, moreover, have far more national significance and validity than do academic records. Amazing differences exist in the educational achievement and future promise of pupils from different schools in the same state, or even from the same city. State and city norms likewise differ widely from each other. Even for accredited institutions giving comparable degrees, the Pennsylvania Study,[3] for example, has revealed the *best* students in certain "colleges" show a level of achievement below that of the *worst* students in some others.

IV

Probably the most common fallacy, or oversight, in testing today is careless neglect of this simple fact—that every test should be tried out and standardized in respect to the group on which it is going to be used. There is altogether too much loose assumption, because a certain "reliability and validity" have once been reported for a test, that this fixes a constant measure of these values. Validity is not inherent in any examination, irrespective of the group tested. If it were, we could use the Otis or the Stanford Achievement or the Thorndike Test or a College Board examination with equal effectiveness among literate English-speaking South Africans, Hawaiians, Australians, Englishmen, and Americans. (In fact if a test had absolute validity even the "literate English-speaking" condition might be removed and the examination extend to Hottentots, Malays, and Bushmen as well.) The necessity for using tests appropriate to the general culture of those tested, and fully comprehensible by them, is thus obvious; yet almost equally important considerations as to the background, educational level, experience and degree of selection in general—characteristic of the school and population to be examined—have often been completely ignored in the administration of psychological tests and the interpretation of their results.

This stricture must be emphasized especially in respect to examinations which are good in themselves, adequately standardized and reliable for a particular purpose, but which are later uncritically employed with groups quite dissimilar from those for whom they were originally devised. Pupils in different grades, apart from their scholastic achievement or intelligence, may react to the same questions in quite different ways simply because of their

[3] "The 1932 College Sophomore Testing Program." Report by the Advisory Committee on College Testing. *The Educational Record,* Vol. XIII, No. 4, October 1932, pp. 290 ff.

greater or less maturity. Tests designed for a certain grade may yield curiously contradictory results from a more advanced or sophisticated population whose greater insight opens up unexpected meanings or connotations. Extensive analysis of individual (true-false) items in a series of final Law School examinations reveals that about one question out of six is answered "correctly" by more poor students than it is by superior ones. The latter read into the problem complications not intended by the instructor or visualized by their less able classmates. An early form of the Legal Aptitude Test was tried out on the faculty, honor students, and entering class of the Yale Law School, as well as upon undergraduate freshmen. The less mature and unsophisticated entrants did better than the faculty on certain items designed to test "logical inference" or "legal principles" —obviously not because they knew *more* law but because they knew *none*. The questions had been designed to test a naive, not a learned, mind. In other words the reliability and validity of specific test items may vary considerably for different educational levels. Even the best of tests should not be expected to operate effectively unless the conditions and the people tested are those for whom it is appropriate.

Furthermore, certain tests now constantly advertised and extensively used appear never to have been satisfactorily standardized on any adequate group. They, too, *may* be good tests, but there is precious little evidence to prove it. As the author has already published illustrations of this point[4] he will not elaborate it further here. Suffice it to say that but little scientific substantiation has thus far been offered of the claims advanced for numerous tests on the market today.

Individual guidance is a sort of mental physic, and as in the case of any other medicine, its contents and action should be known to the doctor and its power suited to the patient. The right sort of psychological examinations, properly used, may often prove extraordinarily effective instruments for educational and vocational guidance. Their employment carelessly, indiscriminately or (even with the best of intentions) too naively may do positive harm to some of those counseled. More scientific scrutiny and control of these instruments which, like drugs, have their dangerous as well as helpful possibilities, is badly needed. By no means should we forego their use—but we ought to have a psychological pharmacopoeia, to say nothing of a Pure Norms and Tests Act.

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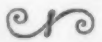
[4] Crawford, Albert B. "Some Criticisms of Current Practice in Educational Measurements." *Harvard Teachers Record*, Vol. 3, No. 2, April 1933.



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TESTS AND TECHNIQUES

In a State-Wide Minimal Guidance Program

HERBERT A. TOOPS

IN FORMING, either theoretically or practically, a state-wide guidance program for high school pupils, one differs somewhat in one's viewpoints from a high school principal who attempts to formulate a local guidance program. In the first case, ideals are set, and the difficulties of execution in concrete situations are minimized.

The local high school principal, on the other hand, is beset with such problems as the scheduling of the hours, rooms, and teachers for each of four successive intelligence tests, the choice of a teacher with interest in and aptitude for counseling, and the redistribution of the teaching load so that the teacher may have time available for interviewing and guidance functions. Yet, having mastered these difficulties, the local principal may confidently look forward to the attainment of positive results. For example, he may assume more or less correctly that most of his pupils and most of his graduates, providing he has an adequate guidance program, will find a more or less satisfactory placement in industry, business, and the professions. At least, all guidance theorists in their texts and treatises make such assumptions. But one who plans a minimal state-wide guidance program must, of necessity, test and question all such assumptions.

In the local situation adequate placement may well be a fact, provided: (1) that there is an ever-increasing demand for, primarily, the "white-collar" occupations; (2) that all or most of his fellow principals, in the larger community of which he is a part, give very little or very inefficient guidance, so that by the default of the latter his pupils have a competitive advantage in placement; (3) that it can be assumed that a larger and larger proportion of the graduates upon graduation will leave the community in order to obtain the occupational placements necessary to bring "opportunity within the grasp of ability, aptitude and interest." In the past all three conditions have obtained to such an extent that any school principal inaugurating a good guidance program confidently could hope to dispose of the product of his school. The picture for the future at first glance is not so rosy in any one of the three aspects.

In the first place, although for forty years the population has been growing very rapidly each year up until about 1927, yielding an *increase* in population larger than the increase of the previous year, the increases of each year since 1927 are *smaller and smaller* with each successive year. Accordingly there is already noticeable a considerable slowing-up of the national population. Statisticians of

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This paper draws heavily from previous publications of the author as follows: Toops, H. A. "A Minimal Guidance Program for Secondary Schools," *Ohio High School Bulletin* No. 9, 24 pp. mimeographed; Toops, Herbert A. "The Possibility of General Selection," *Proceedings of the Association of Ohio College Registrars and Examiners*, 1933. 19 pp. mimeographed.

population give different estimates of the ultimate population of the country and of the time of its attainment, it is true, but roughly there is remarkable agreement in their predictions:—

(1) That we shall add only 20 millions to 60 millions more to our population; (2) that most of our future national population growth will have been completed in the next 30 to 50 years at most.

The possible implications of the slowing-up and ultimate stoppage of growth of the population are momentous. As an example, in future the farmer who invests in a farm cannot hope that an ever-and-ever increasing number of mouths to feed and backs to clothe will continue to mean an ever-and-ever increasing demand for his corn, wheat, hogs, and wool. Again, the industrialist who constructs a factory cannot hope for a constantly increasing demand for his products and rising profits from them, unless they be unique, answering a new demand created by new wants of consumers, and also relatively freed from competition by such expedients as patent-protection.

A second very important implication lies in the statistics on growth of population. Since 1890, when practically no one went to school, the whole high school movement has come about. At the present moment practically every grade school graduate in Ohio (which has an 18-year minimum age leaving limit—earlier in case of proven need) at least starts to high school. With every two grades of schooling obtained, the pupils correspondingly affected hope to rise over the status of their parents by at least one step in the socio-economic scale indicated by the qualitative labels of: labor, unskilled factory work, trades, business, executive and managerial work, professions. This is a precious American tradition—the tradition, concretely, that "In America anybody can become president." Such a trend of socio-economic rise of son over father might presumably continue indefinitely if the population of the country should continue to increase as it did between 1910 and 1927.

Corresponding to the high school development, a somewhat delayed but equally impressive movement recently has occurred in the number of people going to college, and consequently in the numbers of college graduates and people intending to enter the professions. As recently as three decades ago people knew little or nothing of the engineer, the chemist, the physicist, the professional inventor, the research worker, and all that host of professional people that have made 1933 a more livable year—depressions excepted—than any year in all history.

Each year it is increasingly apparent that we are approaching the saturation point in the top-most occupations, even as in production of automobiles. The amount of work to be done in the old way is decreasing all along the line. Most of our forests have been cleared. A great many of our bridges and roads have been built. We have as many schoolhouses as we need, and in fact are demolishing schoolhouses faster than we are building them. We do not have nearly as many hospitals as we need, but we do have almost as many as we are able to afford at the excessive fees charged for the services rendered. We have an excess of farmers, although not an excess of farm products in the hands of all potential consumers. There are entirely too many stores, and four times as many filling stations as the country needs. In fact we have almost enough or far too many of everything produced by the big existing occupations. Is it not obvious that the graduate of tomorrow, either of high

school or of college, must seek to render an unique service to humanity, one now not rendered at all or at least fulfilled imperfectly?

If this conclusion be accepted, then the great problem in guidance for the future, as the writer sees it, is that of exploiting the unusual capacities, specialized abilities, rare experiences, and specialized training of all pupils. On the side of school organization, the problem would involve the devising of an educational system which would turn out individuals better equipped with initiative and adaptability than ever before. A uniform standardized curriculum simply does not fit the need. The ancient and honorable curriculum of Latin, algebra, geometry, English, ancient history, and geography will be due for a pretty careful overhauling in the next 40 years. So also will the curricula of the colleges be compelled to respond to the changed condition of affairs.

Now let us return for a moment to the second condition above, namely, that any school might readily place its graduates and its eliminees provided its fellow schools were lacking in the guidance function. If we admit the possibility of a thorough overhauling of education generally, then is it not immediately obvious that guidance will become one of the most important functions of every school system? Will not every school be compelled as a self-protective measure—if no worthier motive be found—to adopt at least a minimal guidance program? It seems reasonable to suppose that the school of the future will be more concerned with attempting to induce in the pupil a great eagerness for learning than with efforts to cram home a set number of pages in any set curriculum or even in any highly individualized curriculum. Increased emphasis may also be predicted in the matter of providing for the student those minimal tools which make possible continued learning throughout life, namely: reading, efficient computation, rules of thinking, and techniques of writing, drawing and speech-making *in order to influence people*. It seems not illogical to expect in 20 or 30 or 40 years that the schools may abolish diplomas entirely and that every graduate of every grade automatically may be considered to be a candidate enrolled in the next grade. Instead of expressing success or failure by a single percentage mark, for example, each pupil might receive many detailed marks in each subject pursued—for example, a mark in knowledge attained, another in thinking power, another in ability to make inferences and apply principles, another in vocabulary attained, another in the social and ethical implications of the principles of the subject matter. In brief, education may become strictly professional. Guidance may be a part of the training and practice of every school administrator. And, from the viewpoint of our problem, no school could hope to function satisfactorily by reason of the default of any or every other school in the guidance function.

When we consider the third possibility—that the school might satisfactorily place all its pupils in case a great many emigrate to other communities to effect a satisfactory placement—it is obvious that already there is a considerable reversal of the trend from country to city which was characteristic of the past thirty years. Likewise such a readjustment can take place maximally only in a rapidly expanding population. From this line of reasoning it would seem that communities will be compelled to be increasingly self-sufficient, will have to

make occupational provisions for a larger and larger portion of their inhabitants.

II

Summing up the entire matter then, as never before the times call for an education which will enable the individual to be adaptable in a future which he is incapable as never before of anticipating. Such an education will be a true consumer's education, and probably will come about only after there has been a widespread attempt by competent research workers to determine "the forty things most worth knowing." This curriculum revision movement will in general retain those subjects which will add to the individual's "general adaptability."

Social philosophers are convinced that the next 40 years will show a great increase in education for leisure; that professional treatment of every human need will become a commonplace; and that increasingly the pursued occupations of mankind will group themselves at or near the top of the socio-economic series mentioned above. Granting these premises, the academic struggle of cultural vs. practical education must be dropped. Educators will be obliged to concentrate upon devising a carefully-planned curriculum which will hold the best features of both cultural and practical education, and which will aim, in the elementary and secondary schools, at training for adaptability. On the face of things, Latin, Greek, algebra, and geometry will not be grist for the educational hopper.

In all the turmoil which the author predicts as imminent each local school administrator rightfully will strive to secure the best possible education and the best possible placement for his graduates and eliminees. These administrators will serve, as well as may be hoped for, to exploit the individual aptitudes of all idiosyncratic ("differing") individuals. The program obviously needs support, however, from centralized sources such as the State Department of Education and the State College Association.

Briefly the future program should consider the following basic factors:

1. The enormous need for the high school to provide occupational and life training for those who now drop out without graduating. A college-preparatory education does not meet their needs.
2. The enormous wastage of intellectual talent which fails to continue in school to the point of maximal individual profit.
3. The need for scholarships for students with the ability to succeed in college, who are possessed of vision but are not possessed of financial means.
4. The wasted effort spent in college on those who come for other than educational purposes.
5. The impending over-supply of workers in the clerical, managerial, and professional occupations—*unless* we revise our concepts of the amount of such services needed in the world and the means of payment.
6. Neither high school nor college is fulfilling its best functions. The high school holds to an outworn ideal of culture and college-preparation at the expense of adequate provisions for those of lesser intelligence. The college neglects its important function of training the leaders of tomorrow. Both, obviously, need to overhaul aims, curricula, teaching methods, and teaching equipment.

The educational needs of all adults are not being met simply by enrolling in the colleges some 10 per cent of high school graduates and eliminating one-third to two-thirds of them before graduation. Clearly then, we need: to provide useful educations for those who cannot

keep the pace in a college preparatory program in high school; to plan for the few individuals in high school who desire to join an occupation for which college training is no great advantage if not a detriment; to attempt to prepare the attitudes of pupils for the industrial, economic, and social changes which are imminent; to release the high schools from their bondage to college entrance requirements; to give every pupil a chance, if possible, not only to attend but also to profit by high school; to eliminate the feeling—too often a true feeling—that education has nothing more to contribute to the individual after he receives his diploma; to revise the curricula of the colleges in the light of the impending changes in the nature of occupations; to prepare leaders for the increasing problems which for the next two or three generations we undoubtedly shall face by reason of the transition from a rapidly-growing to a stable, grown-up society; and to prepare for a profitable use of the increasing leisure which a grown-up but progressive society abundantly affords.

A number of conditions, primarily of a planning and a standardizing nature, must receive the care and attention of some official central body if all these aims are to be attained. The practicing philosophy of a local principal may differ and should differ, in the way above noted, from the philosophy of the whole statewide movement which cannot postulate a "mobility of labor" to other states and foreign countries—as yet. (We may be thankful we do not have, or are not likely to have, the excess-population problem of Japan!)

If the colleges and the secondary schools and the elementary schools are to cooperate to the best advantage, there must be a great deal of standardization of record forms, of tests and test units. Technical guidance vocabularies must be made uniform if even a minimal guidance program is to function efficiently, and to the additional end that fellow-workers in guidance shall be able to understand one another in regional and state-wide conferences, when making or listening to speeches, and when reading or discussing the more formal treatises on guidance. Serial numbers for all employed teachers, for all schools, political subdivisions, curricula, etc., should be arranged to allow centralized school statistics to be speedily amassed by punch card methods. These records should have a maximal amount of common definition of terms employed and a maximal amount of "usability of the results." These matters are of no small moment for the eventual success of the future education as envisioned, and so must be provided for by a headquarters organization.

III

Such requirements, as they have developed year by year, have led to the creation of a continuing research body in the Ohio College Association—the Committee on Intelligence Tests for Entrance. This Committee has demonstrated by a state-wide intelligence testing program in Ohio that the colleges of Ohio, several years ago, were drawing almost a "run of the mine" sampling of the graduating seniors. Ohio has some 48,000 high school graduates each year. The intelligence tests show that some 24,000 high school seniors are above college 40-percentile intelligence, measured by norms based on freshmen students tested in the 50 or more Ohio colleges. But the 50 Ohio colleges enroll only 12,000 students and of every centile rank, 1 to 100, which means that these colleges could recruit their present numbers twice over from the

very capable talent of which the state has an abundance. To do so would make college failure unnecessary, save as a possible disciplinary measure. To draw the student body from such talent would raise the level of college instruction and increase the probability of producing the leaders who will be needed in the future.

It is reasonable to believe that, if the curricula were what they might be, the colleges might appeal to far more than 12,000 new individuals annually. On the other hand, the cost of college attendance has been mounting over a long period. Some twenty years ago the colleges of the state estimated at $300 to $350 the average annual expenses of college attendance. Comparable figures published recently quote $600 to $800 as the average outlay. In those same twenty years the "real wages" of farmers, machinists, ministers, clerical workers, teachers—who in the main are the parents of the college students—have not increased to a like deegree. Accordingly we may conclude that college is becoming too expensive. That coincidentally college professors' salaries may be too low and college education too expensive is a paradox for the able college president to solve!

Again the high schools have eliminated enormous numbers of their entrants without diplomas. Many of these are intelligent; and many of those who are not very high in academic intelligence nevertheless possess good to excellent special aptitudes. Any state director of guidance, looking over the field of his administration, would note these reservoirs of intellectual and specialized talents which are not being developed by our current educational system. He would see the graduates and the eliminees with high intelligence or high special aptitude or both, who have "ceased to grow" educationally and intellectually, or even occupationally. Perhaps then the logical conclusion is that the college should go to the student, if now it is too expensive for the student to go to the college; also that perhaps the high school should go to the pupil who has dropped out without graduating.

IV

Just such considerations as these have actuated the Ohio College Association in proposing a minimal guidance program for the Ohio high schools. This program has five objectives:

1. Raising the standard of intellectual competence of teachers in Ohio. [By state statute, all candidates for teaching in Ohio must pass a test of general ability. The minimal standard in the past decade has risen from a 7-percentile intelligence standard to a present 26-percentile lower limit.]

2. The actual inauguration of at least a minimal guidance program in the Ohio secondary schools.

3. Raising the professional and technical excellence of guidance work.

4. The progressive freeing of the secondary schools from the bondage of college-entrance requirements, as rapidly as they give evidence through adoption of guidance measures and revised curricula of willingness to accept the corresponding responsibilities.

5. The promotion in the Ohio colleges of a competent personnel program looking toward the ultimate revision of college curricula and personnel practices.

Only the second of the above measures can be discussed in the space available. Accordingly, we present only a selection of the minimal proposals recently distributed to 1,800 Ohio high schools:

1. *Annual intelligence tests of every Ohio high school pupil,* so that by the time the pupil is ready for college a very

reliable measure of his intellectual promise will be available.

Justification: No instrument thus far devised is so effective as the intelligence test to bring about understanding of the individuality of the child, his capacities, and limitations, and to spread abroad in the land a conviction of the very urgent need for individual adaptation of curricula.

A single intelligence test of an individual may be an unreliable measure of his promise. It is highly desirable therefore to have an annual intelligence test and to let college guidance, for example, be based upon the results of from two to four such annual tests. In Ohio, by an ingenious adaptation of test methods, we have reduced the per capita price of a two-hour work-limit intelligence test to about 2½ cents, making the total bill for a pupil's four testings throughout high school amount to approximately 10 cents.

One of the important outcomes of this testing program will be, we hope, the realization on the part of the high school teacher of the tremendous number of very capable people for whom at the present time no adequate educational provision has been made. As a second objective we hope to convince the high school authorities that this waste of intelligence is no new phenomenon, that it has been going on for years, and that in this group there might be many individuals who would be much interested in extension education of a worthwhile type if it could be brought to them in an interesting way.

2. *Annual scholarship tests of every pupil,* on tests carefully designed to measure "the newer objectives of education." These should be accompanied by syllabi of minimal essentials, formerly planned and distributed but recently abandoned as a result of legislative deficiencies.

Justification: Such contests put scholarship on a par with athletics as to desirability in the pupils' eyes. Painstakingly devised, such tests can become the pacesetter of aims for the secondary schools of our state as well as prognosticators of college success. As soon as such tests can be made diagnostic they will be invaluable for remediation of tool subjects and for testing the merits of competing pedagogical methods. When several such tests, each measuring a separate outcome of a given subject—technical vocabulary, knowledge, thinking power, ability to apply principles to every-day situations—shall have come into universal use in our elementary and secondary schools and colleges, we shall have attained an even more important instrument than the intelligence test for rendering visible and making concrete the need for revision of the curriculum.

3. *An annual transmutation to a common basis by Hollerith machine of the marks of all graduating Ohio high school seniors.*

Justification: An average mark of 60 or 70 in High School "A" often indicates the same degree of attainment as an average mark of 90 in High School "B." Statistical methods are available[1] for rendering comparable the marks of different high schools.

Marks measure certain character qualities not otherwise measured. Obviously a high average mark over four years can be obtained only through brilliance or systematic high industry, or both. Likewise a low average mark over four years means low intelligence or a systematic lack of application. It is reasonable to presuppose that the individual habit of success or failure is very important, and the dispersion (standard deviation) of the

[1] Toops, Herbert A. "The Transmutation of Marks," *O. C. A. Bulletin No. 88,* pp. 1093-2000.

marks should reveal something of their significance in this respect. Concretely, two boys "H" and "K" average 2.00 (average) in scholarship, but "H" has received A, B, C, D and E marks in about equal proportions, while "K" has made "practically straight C's." Which of the two offers the better chance of "academic salvation?"

4. *The placing of a copy of a revision of "Opportunities in Ohio Colleges"*[2]*—a composite catalog of all of the 50 or more Ohio Colleges—in the hands of every senior early in his senior year.*

Justification: Every pupil should make inquiry into several colleges before choosing which college he will enter.

5. *The annual distribution to each parent of each child of a form blank on which the parent may request interviews with the pupil's teacher, the school guidance counselor, or representatives of Ohio colleges.*

6. *The appointment in each school of at least one teacher (or principal) to serve as a guidance counselor for the school.* The teaching burden of this teacher should be lightened sufficiently to enable him actually to function in this capacity.

7. *The holding annually of at least one guidance interview with every pupil, no matter whether he seems to need it or not.* For those known to have problems, as well as those found to have unsuspected problems, appropriate programs of action will be mapped out.

8. *The adoption, as soon as a satisfactory one can be devised, of a uniform cumulative record blank for the Ohio high schools,* with a time projection, to supply the colleges and subsequent schools with a much more complete account of the pupil's abilities, attitudes, plans, and ambitions than hitherto has been possible.

9. *Each school to make some special provision for the one pupil in a school who wants to be an author, or a dramatist, or an efficiency manager — the one future representative of an occupation from the school in question.*

10. *An attempt to do something to further the education of the graduates of the last year or two who are not able to go to college; particularly those who are at the present time unemployed.* The seriousness of the problem of hundreds of thousands of unemployed youth, unable or unwilling to attend school, warrants something drastic being done at the present moment.

11. *An annual physical examination of all pupils, with a subsequent attempt to treat all remediable defects.*

12. *Induce all teachers to read Guidance Manual No. 1.*[3]

13. *Average the high school marks of every senior for his entire high school career.* Report his average and rank to each such pupil, and discuss its significance from the viewpoint of his probable success in college.

14. *Obtain for the school library a good supply of college catalogs.* Keep several copies of "Opportunities in Ohio Colleges" on the same shelf.

15. *Give at least one assembly talk on "Going to College" or on "College and Career."*

16. *Give stressed group attention to the guidance of the following groups of pupils:*

a. Girls, generally. (In a depression the problem of occupations for girls becomes acute.)

[2] Edgerton, H. A., and Toops, H. A. *Opportunities in Ohio Colleges.* State Department of Education, Columbus, Ohio, Guidance Manual No. 3, 1931, 203 pp.

[3] State Department of Education, Columbus, Ohio, *Introduction to Guidance,* 1931, 349 pp.

b. Boys and girls with parents who are not professional people.

c. Girls who have decided to go into teaching (below college grade), stenography, and nursing — occupations which are overcrowded at the present time.

d. Boys and girls who have not yet decided regarding college, particularly the brilliant and scholarly.

e. Brilliant and scholarly boys and girls who have decided against going to college for financial reasons.

17. *Each teacher should be asked to read one book on guidance annually.*

18. *The Ohio colleges to adopt a uniform college entrance blank,* so that the school principal can make out the college application blank for *every* senior, regardless of college intention, before leaving for his vacation and while every teacher is available to supply any needed information. This will have the effect in time of making every senior capable of college attendance think of college as a possibility.

19. *The Ohio colleges, with the approval of the standardizing agencies, to free the high schools from college entrance considerations at least so far as the senior year is concerned.* The senior year might then be used for needed remediation, for a special occupational training of those definitely not going to college, and in some cases to speed up the time of entry to college by allowing pupils to take more than the normal load of work. Anything which will bring about the abolition of the present breaks between the several school systems is devoutly to be desired. Freedom from college entrance considerations should also bring about a curriculum more appropriate to the needs of individual pupils, keeping always in mind the fact that the next 40 years will be considerably different from the past 40 years.

20. *The preparation of a mimeographed book of the ratings on intelligence, scholastic tests, transmuted marks, and college intentions of all seniors of all high schools annually,* a copy of which might be furnished to each college by March 1.

21. *The annual formal notification of the 20,000 or more high school seniors of "highest aptitude" in regard to their probable unconditional admission to any of the Ohio colleges.* If colleges be unwilling to go so far, then to certain (specified) colleges. This formal notification, obviously, would have no concern with the pupil's expressed intention of going or of not going to college. Its purpose is simply to stimulate a larger number of the promising pupils to apply. The ideal is to make the applying an automatic procedure, just as at the present time any eighth grade graduate automatically is a candidate for high school.

V

To inaugurate such a program with the least difficulty there should be little or no discouragement from central headquarters of the 28,000 seniors of lesser promise, other than that implied in a failure to receive such a notice. The discouragement, with respect to college, of those of lesser intellect should be done by the high school counselor in conference with the pupil and (or) his parents, and should be "the logical decision" of the pupil and his parents. This procedure may be followed with real advantage to each individual, provided the school discovers what special talent each such pupil possesses and then endeavors to enlighten and interest him in the possibilities of such aptitude-exploiting careers. Surely interests are no more sacred than

knowledges, attitudes, and skills. And consequently—as in the analogous cases—schools should seek to change interests when they are not in line with the pupil's ability, but, in accordance with accepted guidance philosophy, should not seek to enforce compliance.

Such a program as we have outlined above is both minimal and, perhaps for the time, ideal. We do feel, however, that in Ohio we have made a great deal of progress along the directions indicated. We are optimistic enough to hope that a decade of prosperity will not only see the more worthy portions of the above program adopted but also a great deal more which at the present moment we cannot foresee. A highly-trained and highly-paid guidance counselor and a formal guidance department or research bureau is not essential to good guidance. The problem, as the Ohio College Association Committee sees it, is simply to assist wherever possible by technical advice and encouragement of discussion in forwarding the movement in its initial stages. The next 40 years bid fair to stress "quality" rather than "quantity" in professional thinking, public discussion, and education. There is no doubt in our minds, therefore, of the recognition of the importance of guidance as a school function in the educational program of the future.

HERBERT A. TOOPS ("Tests and Techniques in a State-wide Minimal Guidance Program") is Professor of Psychology, Ohio State University. During the war, Dr. Toops standardized and later assembled trade tests in some 90 different trades. Following the armistice he adapted trade tests for the U. S. Employment Service, and later specialized in the construction of vocational tests for the Army. In connection with his present appointment, he directs the intelligence testing program at Ohio State University, the cooperative researches of the Ohio colleges, and the state-wide high school intelligence testing program. He has served on a number of educational committees and as statistical consultant on important researches, notably the mechanical ability investigation at the University of Minnesota. At present he is striving to interest the high schools and colleges of Ohio in uniform personnel practices, a minimal guidance program, conservation of human talent, and scholarships for the able but needy. He is author or co-author of many articles, research reports, monographs, and books.

TROUBLE WAS, IT WIGGLED

Adjustment Service, New York City, reports a recent client who, after spending several minutes in a futile effort to assemble the O'Connor Wiggly Block, said to the counselor: "I can't put that thing together—it's warped."

SCIENTIFIC PERSONNEL SELECTION

In the United States Civil Service

L. J. O'ROURKE

MANY vocational counselors as well as commercial teachers have voiced the need for a more objective basis of determining the actual qualifications which industry demands of employes, the relative proficiency of people who are considered satisfactory by industrial firms, and the extent to which the requirements vary in different industries. Obviously it is important to know whether or not, from the standpoint of the requirements of practical work, we are giving too much or too little attention to each subject in our curricula.

During the past year or two, the U. S. Civil Service Commission has been carrying on cooperative studies with various industrial firms. The objectives of the project are, in addition to improving selection methods, to determine standards in industry and Government; to determine the degree of attainment in each commercial subject which must be reached if the student is to meet the requirements of industry; to release these data to the counselors as a basis for adjusting their problems; to make available to schools the measures by which the attainment of students can be determined, in order that it can be ascertained, a year or more in advance of graduation, in which subject or subjects the students need additional instruction.

Our preliminary study of the causes of dismissal of stenographers indicates that additional time might more profitably be devoted to improving command of English than to acquiring an exceptionally high speed in taking dictation.

Before the stenographic program was undertaken in industry, great care was exercised to insure that the tests to be used should be the ones best suited to the selection of stenographers and typists. Careful study was made of the selection methods and tests previously used by the Commission, and those used by private industry.

Since it has been a generally expressed criticism in the past that stenographers and typists secured through former examinations were "unable to use their heads," a general test consisting of judgment, vocabulary, reading, comprehension, spelling, and English usage items was introduced into the examination. This test is a measure of the adaptability and the knowledge which a typist or a stenographer should have. Comparative results of these tests are shown in Table I.

In addition to the general test, the new examination consists of two tests of actual typewriting ability, and, for stenographers, two tests of stenographic ability.

When the research work incident to the construction of the new tests had been completed, arrangements were made to administer them to the employes of certain of the country's largest industrial firms. The industries cooperating include the American Telephone and Telegraph Company, the Standard Oil Company of New Jersey, the Chicago and New Jersey branches of the Western Electric Com-

TABLE I
GENERAL TEST PERCENTILES

No. of Errors and Omissions on General Test	Civil Service Per Cent Score	Civil Service Eligibles S. & T.	Employes of Eight Industries		Employes of One Industry		Civil Service Applicants Sten. and Typists	High School Seniors Stenographers Only
			Stenographers	Typists	Stenographers	Typists		
0	100	100	100	100	100	100	100	100
5	98.5	99.5	99	100	100	100	100	100
10	95	94	96	98	100	98	98	97
15	90	81	83	97	79	98	93	94
20	85	65	69	93	60	93	85	72
25	80	46	56	82	42	88	71	63
30	75	25	38	76	23	81	57	25
35	69	6	30	60	15	70	42	19
40	60	0	19	48	6	49	25	12
45	Below 60	0	8	32	0	19	12	3
50	Below 60	0	3	22	0	14	8	3
55	Below 60	0	3	12	0	5	2	0
60	Below 60	0	1	4	0	0	1	0
65	Below 60	0	0	2	0	0	0	0

By consulting the General Test percentile table here presented, the following relationships concerning a student who makes 25 errors on the General Test can be readily observed: (1) His performance would earn a civil service score of 80. (2) He is superior to 46 per cent of the eligibles on the civil service typist and stenographer registers. (3) He is superior to 56 per cent of industrial stenographers, etc.

pany, the Detroit Edison Company, the Ralston Purina Company, the R. R. Donnelly & Sons Company, the Henry L. Doherty Company, and the stenographic forces of the Detroit Schools and others.

The pupil's scores on the tests used in the schools will tell the pupil, as well as the teacher, how each pupil is prepared to meet actual requirements of positions in Government or in industry. For example, the scores may indicate that a pupil's accuracy in transcribing dictation given at 96 words per minute is greater, let us say, than that of 55 per cent of the stenographers in industry, and equal to the civil service passing score, but that his ability to use English is better than, let us say, only 30 per cent of those in industry. This information will be an incentive if it is received by the student a year or more before the completion of his course—it is depressing when learned, as at present, at the employment office or on the job.

The student can also be shown specifically how his qualifications compare with those of employes in various positions in various local industries. This information can also be transmitted advantageously to the prospective employer. The school placement officer, or counselor, knowing the ability of the group of typical employes tested in that industry, can state the applicant's ability in such terms as "better than 80 per cent of your employes in shorthand, better than 70 per cent in English," etc.

Let us assume that, having learned the reqirements of Government and industry, you wish to set a standard of instruction that will insure that your typists, as far as English usage in concerned, will rank among the top 50 per cent in industry. It is a part of the project to provide the schools with charts which will permit them to set their standards. Chart 1 gives such information regarding English Usage.

Reading from 50 over to the line marked "Typists" and from there down to the base line, you find that the top 50 per cent in industry make a score of 42 points or better on the English Usage test. A minimum score of 42 on this test as a graduating requirement would, therefore, insure that all graduates rank with the top 50 per cent of typists in industry in English Usage. Similar information in regard to stenographers shows that a score of 57 is equal to the average.

Let us assume for a moment that a student makes a score of 60 items correct on this test. In order to know how she compares with the people in a given industry, either for the purpose of determining whether or not it is more important that she take additional work in English than in some other subject, or for the purpose of informing an industrial firm how she compares with the people in that firm, as far as her command of English is concerned, we consult the chart which shows that the girl making this score is better than 67 per cent of stenographers in that firm, or in industry in general, depending upon the group on which the curve is based.

CHART 2

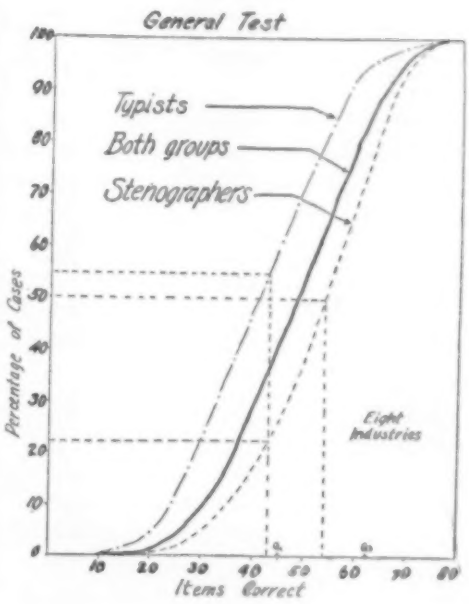
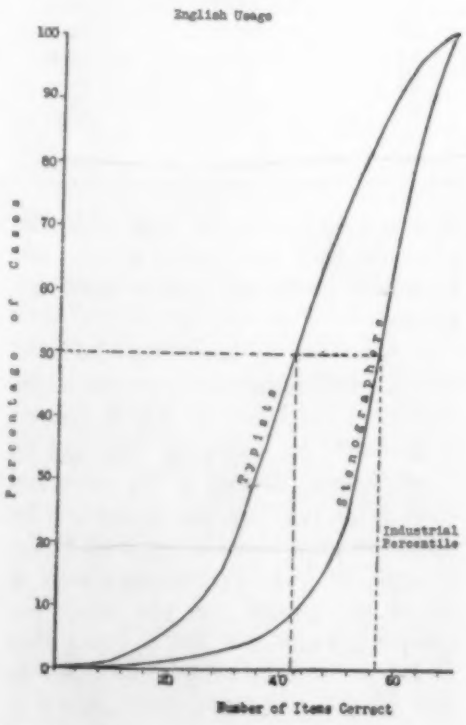


CHART 1



Fifty per cent of the typists in this industry make scores between 33 and 52 on the English Usage test. The middle 50 per cent of stenographers lie between 51 and 62 on this test. The percentile scores on the test are shown in Table II.

The percentile tables (on p. 32) show that the percentage of typists who receive low scores on the English Usage test is much larger than the corresponding percentage of stenographers. For example, 70 per cent of the typists answer 50 or fewer items correctly; only 20 per cent of stenographers fail to answer more than 50 items correctly.

TABLE II

ENGLISH USAGE TEST: INDUSTRIAL PERCENTILES

No. Items Correct	Percentiles		No. Items Correct	Percentiles	
	Typists	Stenographers		Typists	Stenographers
20	6.0	1.0	46	60.0	13.5
21	7.0	1.5	47	63.0	15.0
22	8.0	1.8	48	65.0	16.0
23	9.0	2.0	49	68.0	18.0
24	10.0	2.1			
25	11.0	2.2	50	70.0	20.0
26	12.0	2.3	51	72.5	25.0
27	13.0	2.5	52	75.0	27.0
28	14.0	2.7	53	77.5	32.0
29	15.0	2.9	54	80.0	35.0
			55	81.5	40.0
30	17.0	3.0	56	83.5	45.0
31	20.0	3.2	57	85.0	50.0
32	22.0	3.6	58	87.5	57.5
33	25.0	3.9	59	90.0	60.0
34	27.0	4.2			
35	30.0	4.5	60	91.0	67.5
36	33.0	4.8	61	92.0	70.0
37	35.0	5.0	62	93.0	75.0
38	38.0	6.0	63	94.0	80.0
39	40.0	6.5	64	95.0	85.0
			65	96.0	87.5
40	45.0	7.0	66	97.0	90.0
41	47.5	8.0	67	98.0	95.0
42	50.0	9.0	68	99.0	97.0
43	53.0	10.0	69	100.0	98.5
44	55.0	11.0			
45	58.0	12.0	70	....	100.0

The English Usage test to which I refer has been constructed and standardized in a nation-wide survey sponsored by the Psychological Corporation. This test has been given to some 600,000 pupils from grades 7 to 13, and grade norms are available. The average high school senior answers 55.8 items correctly. Although the general stenographic test includes twenty grammar items, a number of schools and industries prefer to have a separate score on English Usage.

The English Usage test was selected for use in the program of determining industrial and Government standards, because the school norms are available and because a number of the firms which had given the Civil Service stenographic tests have also given this one to their employes.

If we wish to know the industrial standard with regard to the general adaptability test, we would be able to discover immediately by following the line on Chart 2 from 50 over to the curve and down to the base line, that in this case the minimum score would be set at 49. If, for example, an individual makes a score of 43 on the general test, you would immediately know that she is better than 38 per cent in industry, or in other words, that 62 per cent make better scores in

this test. Looking at the base line, you find that the middle 50 per cent in industry range between 39 and 58.

The general test comprises 80 items, 40 items designed to measure judgment, reading ability, and knowledge of vocabulary, 20 designed to measure English usage, and 20 spelling items. A competitor for a Civil Service position is required to answer 43 of the 80 items correctly in order to receive a passing score on that test.

On Chart 3 the bar at the left shows that in one of the industries, 85.10 per cent made scores above this passing mark. In the second industry, 48.78 per cent; in the third industry, 68.42 per cent.

The fourth bar shows that 87.88 per cent of the employes serving as stenographers in a certain public school system score above this passing mark. It should be explained that no stenographer is appointed in this system until she has had two years' experience in industry.

The fifth bar shows that 65.68 per cent of the Civil Service *applicants* make scores above this grade. In other words, those below the passing score, or 34.32 per cent of the applicants are automatically eliminated from further consideration.

It will be seen that the *applicants* for Civil Service positions are about as good, as far as general test scores are concerned, as *employes* in industries. This is the first objective study that indicates the type of applicants that are competing for Civil Service positions.

On Chart 4 the first eight bars indicate the *typists* in each of eight industries in which the general test was given. The height of the bar above the horizontal line indicates the per cent of the group passing the general test and the part of the bar below the line indicates the per cent of the typists in each industry failing the general test. The ninth bar represents all the industrial typists and the tenth bar represents present Government typists. Civil Service standards have now been raised so that no new Government typist would be below the horizontal line representing the present Civil Service passing mark for junior typists.

Chart 5 is similar to the one preceding, but is based on industrial *stenographers*. It will be seen that in each of the industries the stenographers are superior to the typists. As in the preceding chart the ninth bar combines the first eight. The tenth represents Government stenographers, the eleventh represents Civil Service applicants, and the twelfth represents a commercial high school.

In so far as general test, spelling, and English are concerned, the persons *who become eligible* for Civil Service appointment, must make passing scores, and ap-

CHART 3

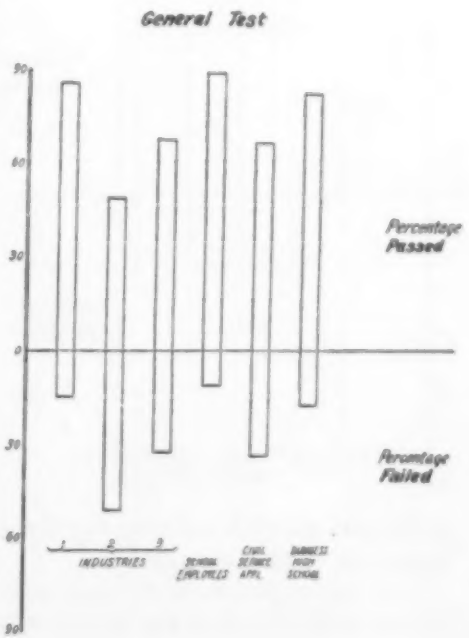


CHART 4

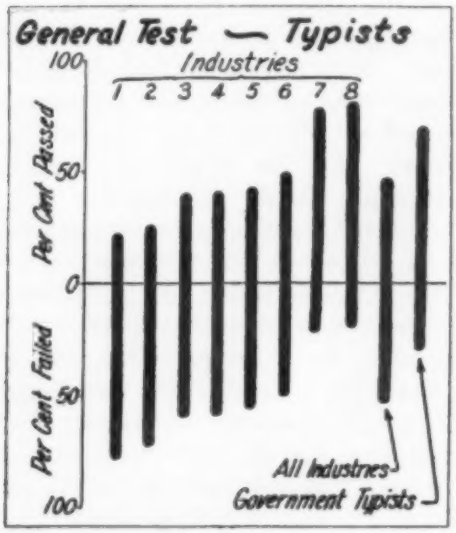


CHART 5

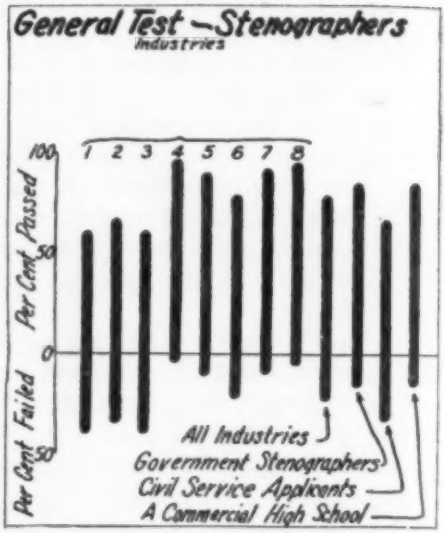
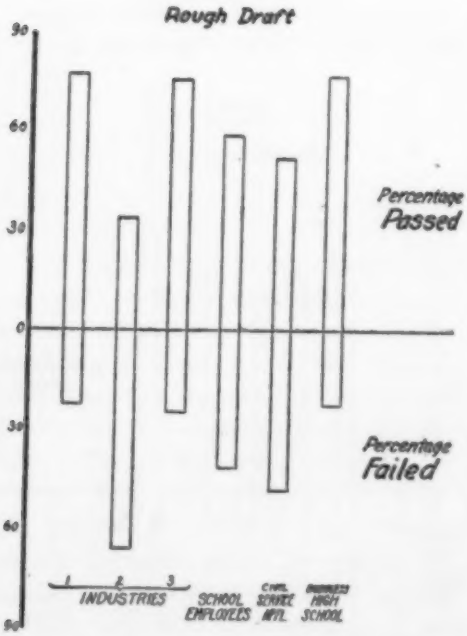


CHART 6



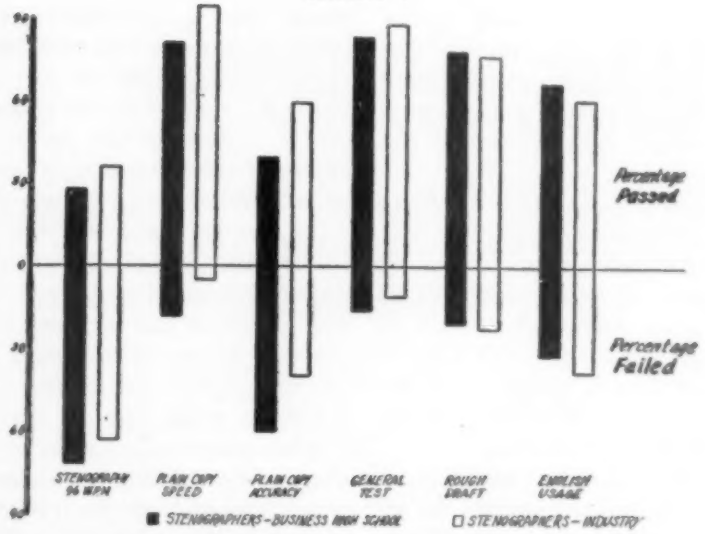
pointments are made from the top of the register of eligible competitors.

The seniors in one of the best commercial high schools in the country rate somewhat above the average in industries on the general test.

The first industry is again higher in rough draft, as shown by Chart 6, 76.59 per cent passing; the second industry, which was lower in the general test, is also lower in the rough draft, 33.68 per cent passing. The industry which ranked third on the general test here ranks almost equal to the first, with 76.04 passing. The school system employes, who rated the highest on the general test, rate fourth on this test, with 57.58 per cent. It will again be seen that Civil Service *applicants* make scores comparable with those of industrial employes. In the commercial high school, the average is considerably above the average of industries in this requirement.

Chart 7 shows the comparison between the combined standards of the industries and those of the high school referred to. The black line indicates the high school and the light line represents the industries. It is evident at the left that the stenographic attainment in the business

CHART 7



high school is approximately equal to the standards in industries. It will be seen, however, that the per cent of applicants meeting the new Civil Service requirements as to stenography is 28. Our standards were too high.

On plain copy speed, it will be seen that again the standards of the business high school are about comparable with the ability of the people in industry.

As far as accuracy in copying from plain copy is concerned, the industrial standard is somewhat above the business high school attainment. However, the industrial standard is 50 per cent lower than the Government requirement.

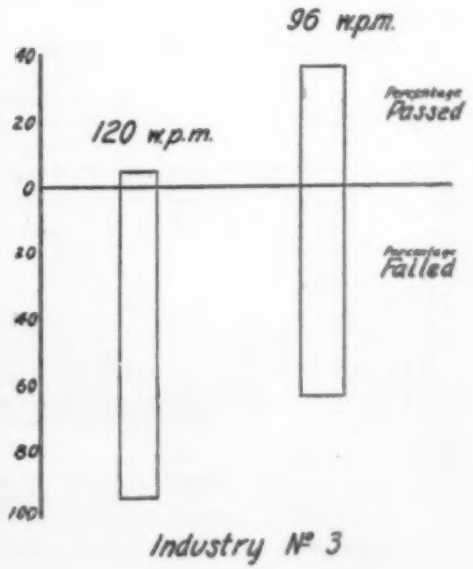
In rough draft, the business high school standard is about equal to that of the industries. In the English Usage, the school's standard is slightly higher than the industries'.

It might be stated, however, that while industries are satisfied with the speed with which stenographers are able to take dictation, they are very much dissatisfied with the attainment in English usage. (The first two lines on Chart 8 referring to stenography, indicate that the 96-word per minute speed is as high a speed as industries demand.)

Fewer than 6 per cent of those employes in industries are able to pass the

CHART 8

Stenography



120-word dictation test. Only 38 per cent can pass this specific 96-word test as administrated in this program. This indicates that beyond this 96-word-a-minute speed, schools might well give more attention to certain other phases of the curriculum.

As a case in point, a study was made of approximately 100 stenographers who passed the 120-word test for entrance into an organization; when these stenographers were tested a year later, the majority were unable to pass the dictation test given at 96-words per minute, showing that the 120-word speed is excessive since it is not demanded in their actual work.

A comparison of the relationship between the general test scores and the efficiency ratings of the employes of two industries cooperating in the studies, as shown in Charts 9 and 10, indicates that the new general test measures factors which the executives have in mind when they speak of "ability to use their heads." These charts show that the new test is a definite step toward insuring that the stenographers and typists appointed as a result of the new examination will possess this ability.

The coefficient of correlation between scores and efficiency ratings of the 51 employes tested in one industry was 0.71. Of the 25 per cent who made the highest scores, approximately 90 per cent were above the average of the group in efficiency. In another study on 80 stenographers and typists of another large industry, a correlation of 0.76 was found between general test scores and efficiency.

On Chart 9 the vertical line at zero on the scale is the dividing line on either side of which fall 50 per cent of the efficiency ratings of the whole group of 80 stenographers and typists. It will be referred to as the average. Each horizontal bar represents one quarter of the group tested. The top bar represents the employes who made the highest 25 per cent of the test scores, hereafter referred to as Group A. The lowest bar represents those who made the lowest 25 per cent of the test scores, or Group D. In each bar, the part at the right of the vertical line indicates the percentage of that group rated above average in efficiency; the part at the left shows the percentage of that group rated below average. The solid white sections combined represent the most efficient 25 per cent of the total number of employes; the solid black

CHART 9

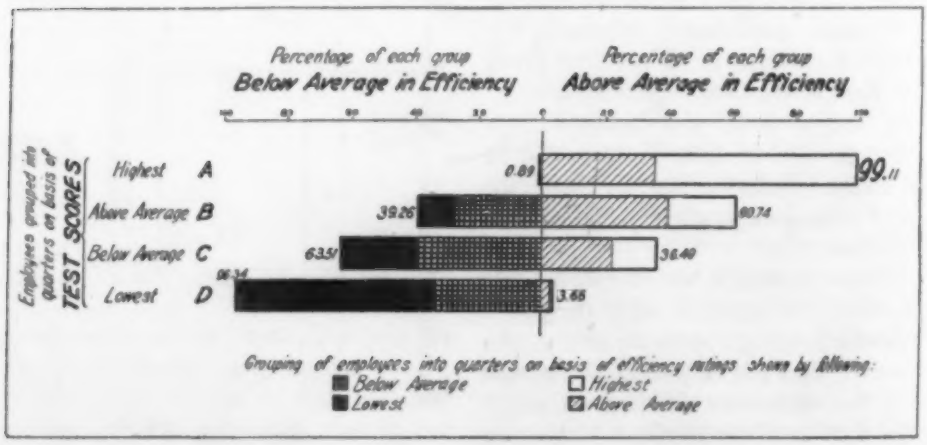
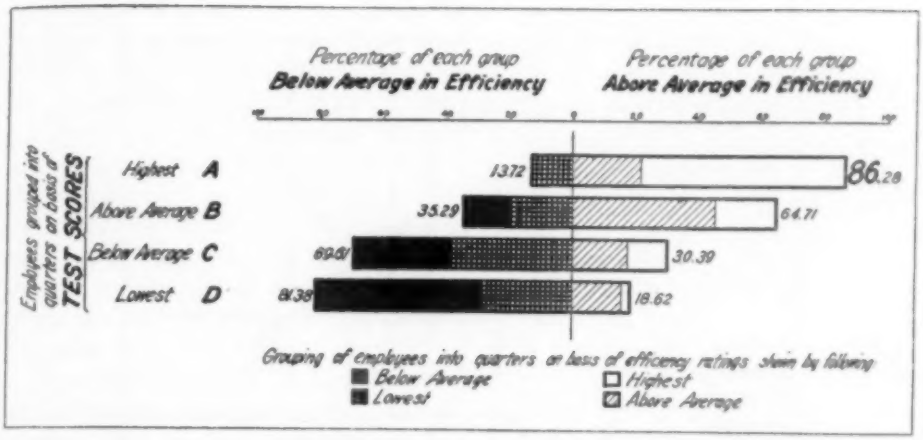


CHART 10



sections are the lowest 25 per cent in efficiency.

The chart shows that of the employes who made the highest 25 per cent of test scores (Group A) 99 per cent were rated above average in efficiency. Of those who made the lowest 25 per cent of test scores (Group D) only 4 per cent were rated above average in efficiency, 96 per cent being rated below average.

This means, in terms of selection, that practically all of those who made scores equal to those of Group A could be expected to be rated higher in efficiency than the average of the employes tested, whereas only 4 per cent of those whose scores are as low as those of Group D would be rated above and 96 per cent would be rated below average. A high general test score is thus actually indicative of aptitude for the work.

The differentiation made by the same test among the group of 51 employes of the other organization is shown on Chart 10. The bars represent the same classification of employes by scores as in the preceding chart.

Of competitors who make scores equal to those made by employes in Group A, the highest group, 86 per cent could be expected to be above average in efficiency of the employes tested. In other words, the chances are 6 to 1 that their efficiency will be above the average of the employes who are tested.

WHICH GIRL WOULD YOU CHOOSE FOR TRAINING AS A SECRETARY?

Comparison of General Averages	
Mary Jones	89
Clara Carter	84

TABLE III

Comparison of Actual Test Scores	Mary Jones	Clara Carter
Stenography	100	72
Rough Draft	91	82
General Test	81	92
English Usage	84	90
Average	89	84

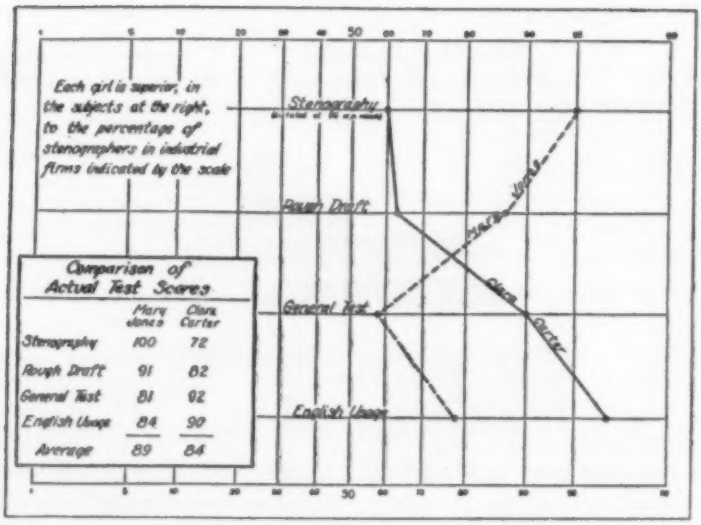
TABLE IV

Industrial Percentiles	50	60	70	80	90	95
Below are the test scores in each subject corresponding to above percentiles						
Stenography	48	72	86	92	98	100
Rough Draft	77	82	84	87	91	95
General Test	79	82	85	89	92	95
English Usage	73	80	83	85	87	89

TABLE V

Suppose that Mary Jones and Clara Carter have taken an examination consisting of tests in stenography, typing from rough draft, English usage, and general intelligence, spelling, etc. You might choose between them on the basis

CHART 11


Each girl is superior, in the subjects at the right, to the percentage of stenographers in industrial firms indicated by the scale
Stenography
Rough Draft
General Test
English Usage
Mary Jones
Clara Carter
Comparison of Actual Test Scores
Mary Jones
Clara Carter
Stenography 100 72
Rough Draft 91 82
General Test 81 92
English Usage 84 90
Average 89 84

of their average scores as shown in Table III. You might do this because you believe that a difference of five points on a good examination would clearly show which of the girls was better for any secretarial or stenographic position.

From Table III, Mary Jones appears to be the girl for the job. But if you wanted to know more about the girls' performances than is shown by average scores, you might ask for the information given in Table IV so that you could see how the girls compared on each of the separate tests in the examination.

Table IV shows that Mary Jones is better in Rough Draft and Stenography than Clara Carter, but that Clara Carter is better in English Usage and Intelligence. You might decide now that it is more important for your prospective secretary to be intelligent than to be superior in anything else, and hence choose Clara Carter. But even if your problem were so simple, you really ought to know how each of the girls compares with stenographers in general, in order to know whether either of them is really superior. Table IV does not even give a good picture of how much better either girl is in any subject, because you don't know what difference of ability is indicated by the difference in the scores in any one test.

If you look at Table V, you will have a better idea of what various scores mean on the various tests, in terms of the percentages of stenographers in industrial firms who get below each score. But although Table V gives you a better idea of the different meanings of scores on the different tests and tells you something as to how the girls compare with each other, you probably would find it difficult to make a choice considering all the subjects as of some importance in a good secretary.

One way of getting a better picture of the girls' abilities is to prepare a chart which shows graphically most of the factors to be considered. Chart 11 shows both the per cent of industrial stenographers to whom each girl is superior in each subject, and how the girls compare with each other. The scale is distorted so that the horizontal distances between two

points are proportional to the differences in ability. We are able to see or to measure that, in total ability, as represented by the distances to the right of the 50 per cent line, the girls are exactly equal, if all subjects are equally important. That is, Mary Jones' superiority in stenography and rough draft is of the same extent as Clara Carter's superiority in English usage and intelligence. The five-point difference in average scores as given in Tables III and IV has no significance whatever.

Note also that Clara Carter did better in stenography than Mary Jones did in the general test, although the scores would indicate a difference of nine points in the other direction.

For the secretarial job, Clara Carter should prove superior, but it is also clear that Mary Jones is superior for a job in which stenography and rough draft are relatively more important than English and intelligence.

Note that we are not ignoring differences in ability in the less important subjects. We have simply determined for the specific example given that the differences in the less important subjects are not large enough to out-weigh the differences in the more important subjects.

This particular study was designed to bring about closer cooperation between Government, industries, and schools. It may well serve as an aid in the study of commercial curricula, involving the determination of industrial and Government standards in stenography, typewriting, English usage, and spelling[1]. Finally, it is suggestive of the type of work which will be necessary if we are to gear the processes of education to the needs of pupils in after-school life. It will be this type of data which the vocational educator and the guidance counselor will come to employ in facilitating the adjustment of pupils in school—an essential step in preparing them to enter occupations for which they are really fitted.

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[1] Copies of the tests referred to may be secured from the U. S. Civil Service Commission.

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GRAPHIC REPRESENTATION

Of Measured Characteristics of Successful Workers

M. R. TRABUE

POPULAR phrases are occasionally very apt in their descriptions of technical procedures. The phrase, "fitting square pegs into square holes," comes a bit too near describing some of the things done in the name of guidance to be entirely pleasing to the psychological ear. In popular discussions, and too frequently in the practice of educational institutions, only two kinds of pegs are considered: "round," and "square." When the educational program and the youth prove to be poorly fitted for each other, the youth is promptly classified as being "round," or "unprepared" for the square holes of the school, and is gently but surely eliminated. The realization that the human pegs supplied by biological nature and modern environment possess hundreds of different shapes, and that most of them are decidedly worth preserving and using in the building of a modern social structure, has not yet come to many of those who are in control of the programs and procedures of educational institutions.

Another fact not recognized in this easily-spoken phrase is that the task of identifying the various characteristics of human beings is extremely complex and difficult. Nothing could be much simpler than the recognition of "squareness" in a peg or in a hole, but few things are more complicated, multi-dimensional, and bewildering than the characters of human beings. If each hole in our industrial peg-board had been carefully surveyed and blue-printed, and each human peg had been carefully measured, classified, and labeled, the task of the vocational guide would be reasonably simple. As a matter of fact, however, success in a given job is dependent upon the possession, not only of the right combination of abilities, but also of the correct attitudes, likes and dislikes, interests, personality traits, social behavior, and the like. Among all of these, perhaps the individual's abilities and skills are most readily subject to objective measurement, and yet very little is yet known about the exact amounts of different kinds of ability actually possessed by those persons who are working successfully and happily in different types of jobs.

The information about occupational requirements most often quoted is chiefly of a subjective character. When a successful man is asked to enumerate the qualities that make for success in his field, he is more than likely, regardless of the field he represents, to name about the same list of adjectives. He is a very unusual person if he does not include such qualities as honesty, intelligence, courtesy, aggressiveness, and loyalty. Where objective measurements have been made, however, it has been found that certain occupations require far less of a given quality than do others, and that in some occupations it is probably as much of a handicap to have a high amount of a certain trait as to have little of it. For each occupation there seems to be required an

optimum degree of each quality, and this optimum is rarely the maximum degree. Instead of assuming that one needs the highest possible amount of a given characteristic in order to be successful, the vocational guide needs to know what degree of the characteristic is typical of successful workers in each different occupation.

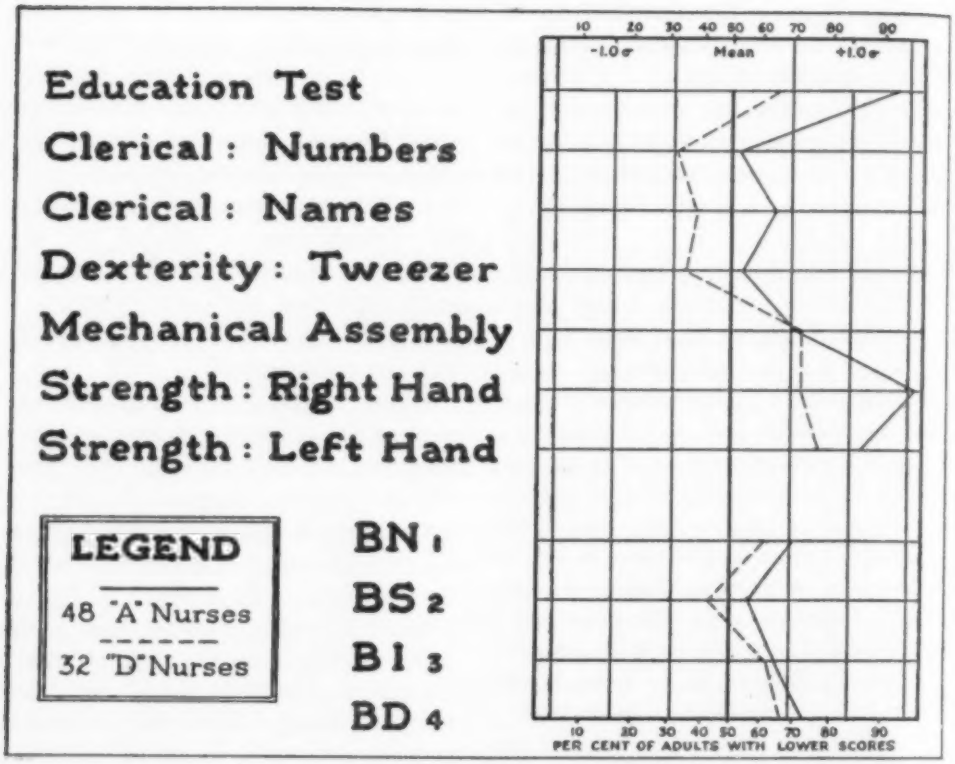
In order to determine how much of a given trait is possessed by a high school or college youth, or how much of it is possessed by successful workers in the occupation he is considering, it is necessary to use some scale or test which will reveal the strength of the trait in an index which can be verified by other examiners. The test must be so reliable that it will give approximately the same index, regardless of who administers it or when. A device which gives one index when administered by a high school teacher and an entirely different index when administered by an employment office clerk is of little or no value for guidance purposes.

It is not sufficient, however, to know that on a certain reliable test Student X made the same score as is commonly obtained by successful workers in the occupation he wishes to enter. A person might be exactly typical of successful clerical workers in his academic intelligence, for example, but be very different from them in other important characteristics. The possession of typical amounts of certain particular characteristics seems in each occupational field to be more important than the possession of typical amounts of certain other characteristics, and the list of characteristics which are important seems to vary with the occupational field. It is interesting to note, in this connection, that in such preliminary attempts as have been made to measure the characteristics of successful workers in an occupation by means of a wide variety of tests, some of the tests which had been assumed to be important were found to be of relatively little value, while others which had been considered relatively unimportant were found to be quite significant. A thoroughgoing program of scientific investigation is needed for the purpose of determining which tests are really significant and what amount of each trait is typical of the best workers in each occupational field.

Figure 1 represents in a graphic way some of the differences in average scores between the "best" (A) and the "poorest" (D) nurses in a group of more than 300 who were measured by the Employment Stabilization Research Institute at the University of Minnesota.[1] The heavy perpendicular line passing through the center of this chart represents for each test the score made by the average adult woman. Along the base of the chart is a scale indicating, for a representative sampling of the total adult population of women, the percentages that normally make scores below the points indicated. The two tests on which the best nurses showed the greatest superiority over the poorest were the education test and the test of strength in the right hand. In each of these tests the best nurses made an average score that was higher than ninety per cent of normal adult women usually make. The chart shows, on the other hand, that there was practically no difference between the good nurses and the poor nurses when measured by means of the Minnesota Mechanical Assembly Test, although both groups of nurses did

[1] Gordon, Phoebe. "Tested Qualities of Graduate Nurses." *Proceedings of the Thirty-ninth Annual Convention of the National League of Nursing Education*, June, 1933, pp. 184-190.

FIGURE 1



better on this test than seventy per cent of the normal or standard group of women.

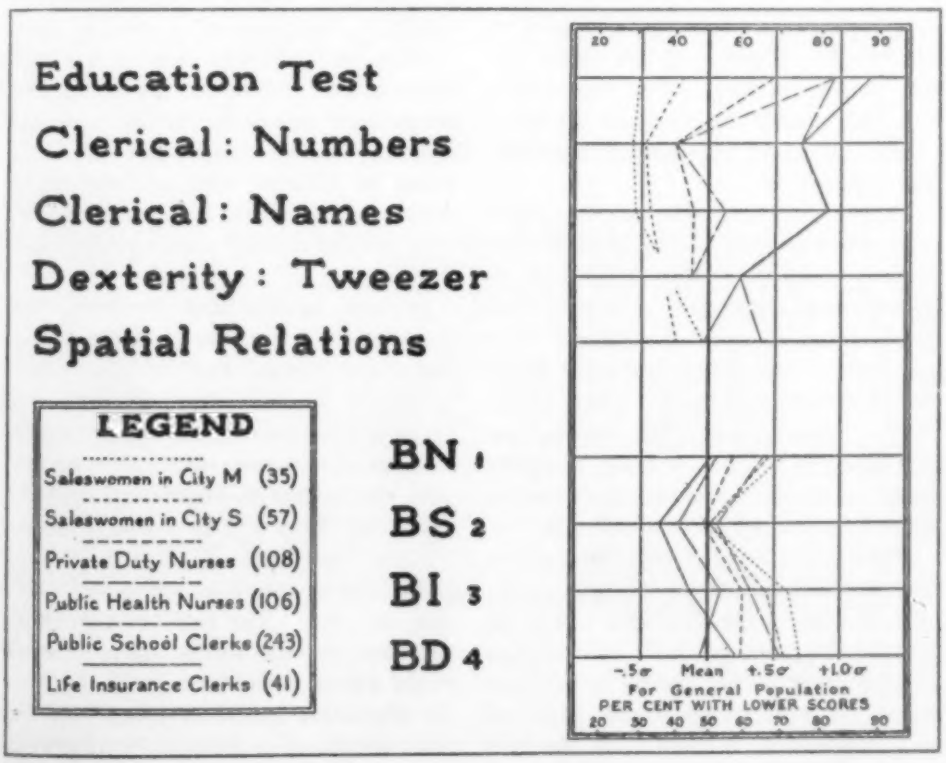
The four lowest scales in Figure 1 represent the results obtained from applying Bernreuter's Personality Inventory. A high score, represented on the chart by distance to the right of the mean, is supposed in BN1 to indicate "nervous stability," in BS2 "self-sufficiency," in BI3 "extroversion," and in BD4 "dominance." It appears from the results presented in Figure 1 that there are relatively small differences between these "best" and "poorest" graduate nurses when measured by Bernreuter's test, and that the averages of either class are not very different from the averages of women in other occupations.

It is possible, of course, that there are many other tests on which the best nurses would differ even more than they differ on these tests from the poor nurses or from the average woman. Until further research has indicated what these better tests may be, however, one is justified, so far as tested general fitness is concerned, in giving encouragement to girls who wish to enter nursing training, if they are found to possess slightly better than average scores on the Minnesota Vocational Test for Clerical Workers and on the O'Connor Tweezer Dexterity Test, together with strength in the hands and academic intelligence superior to about 90 per cent of adult women. It would seem unnecessary, from the results indicated in Figure 1, to use the Bernreuter Personality Inventory, since the differ-

ences between the "best" and the "poorest" nurses are so slight. The Minnesota Mechanical Assembly Test appears to have some value in separating nurses from other women, but it seems to be useless in separating good from poor nurses.

Figure 2 represents the scores made by two groups of women in each of three different occupations: saleswomen from two different department stores, private duty nurses and public health nurses, and clerical workers in public school offices and in a life insurance office. It will be observed in the academic intelligence or "education test" the public health nurses made the same average score as the school clerks, both being slightly higher than 80 per cent of adult women in general. A vocational guide would scarcely be justified, according to these results, in using school grades or scores on "intelligence tests" as a basis for giving advice to a girl who was trying to decide between clerical work and public health nursing as a career. The differences between the abilities of the women in these two occupations are extremely significant, however, when measured on the Minnesota Vocational Test for Clerical Workers. It is possible that later research may develop tests on which the differences between workers in these two occupations will be greater than they are on this one, but at the present time this simple clerical test seems to be the most helpful single test available for making this distinction between clerical workers and nurses.

FIGURE 2



Vocational guidance should not be given on the basis of a single test, however, for the attainment of success in an occupation is dependent upon having the right combination of various characteristics rather than upon the possession of one or two good traits. For example, a girl might have all of the measured traits of the typical saleswoman represented in Figure 2, but be too frail in physical health to be able to accept employment in a department store. She might be quite typical of the saleswoman in her abilities, mental and physical, in her likes and dislikes, in her attitudes and interests, and in her personal ambitions, but be a member of some family in which the social traditions were all against such work. Vocational guidance should be based upon all of the data available regarding the individual's present situation, plus as much as is obtainable regarding the manner in which he has developed into his present status. The more objective and reliable the evidence on these points, the more dependence one may place upon them.

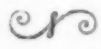
Graphic representation of the scores obtained on a series of tests is made possible by employing a common unit of measurement—in these figures, the standard deviation or sigma of a normal adult population. Any other statistical measure of dispersion in such a group might be used equally well. The essential requirement is to have a fairly complete sampling of the distribution of scores made by a normal adult population.

There are a number of advantages in the graphic presentation of test results. One of these is the ease with which the eye and mind can grasp the relationships to each other of the results in different fields. It would take several pages of this magazine to explain fully the relationships revealed at a glance in Figure 2, and after reading these pages the average person would probably remember less about the relationships than he would from examining the graphic figure for a few minutes. Furthermore, it seems probable that comparisons of six different average scores in each of seven or eight different tests would be rather uninteresting to most people if presented in a statistical table. It is possible, however, that many readers of *Occupations—The Vocational Guidance Magazine* will be more interested in observing how much lower the ability scores of the saleswomen are in the chart than the scores of the clerical workers, and the extent to which in the Bernreuter Personality Inventory the saleswomen showed higher average scores than the clerical workers in "stability" (BN1), "self-sufficiency" (BS2), "extroversion" (BI3), and "dominance" (BD4). Seeing the relationships between the records of different occupational groups on the same test, and especially between the scores of the same group on different tests, enables one to think more definitely of relationships, as such, than he could if numerals only were reported.

It must be admitted, however, that there are dangers in the graphic presentation of test scores. As in all other efforts to give a popular interpretation of a scientific phenomenon, there are dangers of over-simplification and misinterpretation. Some readers might easily get the impression from Figure 2 that all saleswomen showed less ability in the clerical and education tests than any nurse. This was not true. The lines in the graph represent average scores, only. Others might arrive at the false conclusion that the Minnesota Spatial Relations Test was more important in distinguishing between

saleswomen and clerical workers than the Manson Occupational Interest Blank for Women, since the results of the interest blank do not appear on the graph. The mere presence of a given test in a graphic representation may tend to lead uncritical observers to believe that it was considered equal in significance to the others which appear, and superior to those which do not appear. As a matter of fact, however, some of the most important data for use in the guidance of an individual cannot readily be included in a graphic record. Furthermore, representing a fact graphically does not in itself increase its predictive value, its validity, or its reliability in the least.

In spite of these and other dangers of misinterpretation, the "test profile," or graphic representation on a common scale of the different scores of an individual or of a successful occupational group, does call attention to some of the relationships that exist among the scores in different types of tests, and these relationships and patterns of ability have a vocational significance which is something over and above the mere sum of the significances possessed by each test score individually. Such graphs may suggest when it is desirable to determine, although they do not in themselves directly indicate, the seriousness of an individual's deviations from the typical trait pattern of successful workers in the field to which he aspires. When considered as tools, to be used along with other tools and statistical devices for obtaining and presenting useful data about individuals and groups of individuals, test profiles or patterns can serve very useful purposes in guidance. If they were to be considered as ends in themselves, however, or as the only method of evaluating test scores in guidance work, they would not be worth the effort required in their preparation.



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OCCUPATIONAL ABILITY PATTERNS

Some Popular Misconceptions

ROBERT HOPPOCK

THERE is much popular discussion today about occupational ability patterns. The objective of the pattern is commendable; the theory, so far as we know, is fundamentally sound; but the application of the theory to the construction of patterns for immediate use implies assumptions which merit critical appraisal.[1]

Those who have done the most work on patterns are fully aware of their limitations and of the careful validation which must be completed before they can be used generally in practice.[2] Those who are less familiar with them may, in their enthusiasm for something new, overlook the obvious limitations, proceed at once to base their counseling upon unvalidated patterns, or dissipate their energies upon inadequate attempts to construct new ones. Henry Suzzallo once exclaimed, "God save us from our disciples!" It is in the hope of serving the disciples as well as the masters that we endeavor here to suggest some of the limitations of patterns in their present form.

II

Every public discussion of patterns seems to elicit from someone the criticism that the tests on which the patterns are based are of such low reliability and validity[3] that they should not be used for individual diagnosis; and the familiar reply that "the important thing is not the score on any one test, but *the relationship among the test results.*" This may be an adequate answer, or it may not. We cannot logically assume its adequacy until we have more evidence than has yet been published.

To illustrate by analogy, consider the well known fact that single items on a test of intelligence have nowhere near the validity of the test as a whole, and the equally familiar fact that the reliability of a test can be increased by adding more items of equal quality. An intelligence test is always validated against its criterion, and its final reliability is always determined, after the items have been combined. Bitter experience has revealed that, in many cases, validity and reliability both prove to be lower than was anticipated. No maker of occupational patterns may neglect the final step of determining validity and reliability. With-

[1] In attempting to explain the errors which novices may make, it has been difficult to avoid giving the impression that some of the same errors are made by those pioneer psychologists whose vision is responsible for this significant new development in diagnostic technique. Any such impression would be most unfortunate.

[2] Cf. Trabue, M. R.: "Occupational Ability Patterns," *Personnel Journal*, 1933, 11: 344-351.

[3] "The reliability of a test (or any other measuring instrument) is determined by the *consistency* with which it measures the capacity of those taking it."—Garrett, H. E.: *Statistics in Psychology and Education*, New York: Longmans, Green, 1926, p. 268.)

"The validity of any measuring instrument depends on the *fidelity* with which it measures whatever it purports to measure." (*Ibid.*, p. 266.)

out adequate validation[4] against a satisfactory criterion no pattern may be assumed to be any better than the tests upon which it is based. It might even, through the contamination of poor tests, be less useful than some of the single tests in the battery.

III

Graphic charts have frequently been used to illustrate the idea of occupational patterns. Each chart depicts the median and quartile scores[5] made by successful people in one occupation on a battery of aptitude, personality, and intelligence tests, et cetera. The median scores on all of the tests are connected by a line which usually follows a zigzag course from the top to the bottom of the chart. The quartile scores are connected by similar lines. The chart thus represents the central tendency of the scores of many individuals. When the scores of one person are plotted separately, the chart is called a "profile." There is much more to the pattern idea than just a simple chart of this kind. But to the counselor who is trying to advise someone interested in the occupation, it looks like a simple and useful procedure to compare his profile with the chart and then to see how well he fits.

This reasoning implies the assumption that the profile of an individual should follow the median scores (or at least be within the range of the middle fifty percent) of successful people as shown on the pattern if he is to enter the occupation and succeed in it. To reveal the fallacy in this, consider a hypothetical case. Suppose we are constructing a test battery to be used in determining an occupational pattern for portrait painters, and that we decide to include in it a test of radicalism-conservatism in art. It is not unreasonable to suppose that very conservative portrait painters would find a market for their product among conservative buyers. Radical painters likewise might find a good market among buyers of radical preferences. But the middle-of-the-road man, who could never quite make up his mind whether to be radical or conservative, would be more likely to paint a hodgepodge which no one would buy.

Now notice, that if our group of successful painters should include about the same number of radical and conservative men the *median* score would be that of the rare individual who is in the middle, and whose success may be due wholly to some accidental factor which would favor only one in a thousand. Yet it is this very score which our chart might lead us to think is the optimum. We would thus make the unforgivable mistake of guiding into this occupation the very person who has the least chance of succeeding. The same thing might happen in the case of any number of tests in a battery, so long as the chart is based on any kind of average scores.

IV

Another dubious assumption is very apt to be made by those who like to take their technical knowledge graphically because they have been denied the time or

[4] Adequate validation requires the comparison of predictions made from patterns with the *subsequent* success of persons who sought the guidance of patterns and acted upon it. A tentative validation may be made by comparing the pattern with the profiles of a large number of successful individuals who were *not* used in constructing the pattern. We have, unfortunately, seen some attempts to construct patterns and use them without undertaking either kind of validation.

[5] The first quartile is the point below which one-fourth of the cases fall. The third quartile is the point below which three-fourths of the cases fall. Between these points lies the "inter-quartile range," which includes the middle fifty per cent of the cases. The median is the mid-point in any distribution of scores.

the inclination to study statistics. They are, quite naturally, impressed by the fidelity with which the zigzag lines, connecting the scores at the first and third quartiles on the pattern, follow the direction taken by the line which connects the medians. To the neophyte this seems to reveal some sort of internal consistency in the pattern; and, he reasons, why is it so consistent if there is no meaning in it? The answer is simple. If we plotted the scores at the 49th and 51st centiles[6] we would expect to see them follow very closely the scores at the median or 50th centile. Likewise, if we plotted the 48th and 52nd; or the 47th and 53rd. It is inherent in any fairly normal distribution that the bulk of the cases, including the quartiles, should move up or down the scale in the same direction as the median. That the zigzags of the quartiles will resemble those of the median is predetermined by definition before the chart is even drawn. The fact that they do so is no more significant than the fact that the mean is somewhere near the median in most distributions. Only in the case of a skewed or bi-modal distribution (such as that described above in the hypothetical case of the portrait painters) would either of the quartiles spread very far apart from the median. Even in such a case, the nature of the distribution would not change the general direction of the pattern if the modes happened to be both above the 50th centile, while the medians and quartiles of the tests which precede and follow this one are somewhere below the 50th. The apparent internal consistency of the pattern is therefore meaningless as an indication of diagnostic validity.

V

Are occupational patterns then a will-o'-the-wisp? Not at all. Instead, they are a very promising development. But they must be allowed to develop and to demonstrate their validity in experimental applications before the "working counselor" may place in them the faith which some naive counselors now have. Experimentation in practical applications, if properly controlled to assure opportunity for validation, is to be encouraged; not only because we may discover something of immediate practical value, but also because attempts to develop patterns may disclose weaknesses in available aptitude tests and lead to basic improvements in the separate instruments of measurement. Such work, however, must be regarded as experimentation, not as the application to daily problems of a technique which has proved its worth.

[6] A centile is a point below which a given per cent of cases fall. Thus 49% of the cases fall below the 49th centile, 51% below the 51st centile, and so on.

ROBERT HOPPOCK ("Occupational Ability Patterns: Some Popular Misconceptions") is assistant to the director of the National Occupational Conference, and was formerly field secretary of the National Vocational Guidance Association. His major research interest has been job satisfaction. Several years of experience as a working counselor gave Mr. Hoppock the practical viewpoint which is mirrored in this critical article.

THE VOCATIONAL INTEREST TEST

EDWARD K. STRONG, JR.

WHETHER a man has the interests of an engineer, lawyer, accountant, etc., is determined by the Vocational Interest Test. It is assumed that a man will be more effective in his vocational career if he is engaged in work that he likes than if he is forced to do a great many things that he dislikes. Other factors must, of course, be considered in choosing a career; but what a man likes and also what he dislikes play an important rôle.

The Vocational Interest Test[1] is an eight-page blank listing 420 items, to each of which the individual responds by indicating whether he likes it, dislikes it, or is merely indifferent to it. The first page provides opportunity for the individual to record significant information as to his education, jobs held, occupational plans, etc.

The test is designed for males, 15 years of age and over. (A companion blank for females has been printed. Stencils for scoring the women's blank are in process of development but will not be issued for some time.) The blank for men can be scored for interest in 27 occupations (listed in Table II); also for interest maturity, which records the maturity of interest of the individual in comparison to others of the same age.

II

Of what significance are interests?

If a boy likes mathematics, physics, and chemistry and dislikes English, he will most likely decide to be an engineer. On the other hand, if he dislikes the first three subjects and likes English, and if, in addition, he likes to talk, he will plan to be a lawyer. Decisions of this sort are made today because teachers and friends interpret such interests to mean engineering in the first case and law in the second.

As an actual fact the first combination fits about equally well the occupations of farmer, engineer, chemist, dentist, architect, mathematician, physician, physicist, and psychologist, and the second combination is expressive of the early interests of those who later become not only lawyers but also newspaper editors, authors, advertising men, and salesmen of life insurance and real estate.

The above illustrates the fact that young people have always been given vocational counsel in terms of their expressed interests. It illustrates the further fact that amateur counselors have been perfectly willing to base their advice on one or two evidences of interest and usually have not doubted their ability to interpret such interests in terms of occupational careers.

The more one studies the problem of vocational guidance the more one is impressed with the complexity of the subject. Space is not available here to discuss the various difficulties involved. Fortunately, they are treated by others in this series of articles. Our primary concern now is the relationship of interests to occupational choice, though we

[1] Requests for samples of the blank and inquiries as to cost of blank and stencils for scoring should be addressed to Stanford University Press, Stanford University, California.

must not forget that this is only one of many factors that must be considered.

Various investigators have made clear that a boy's expressed choice of his future occupation is very apt to change from year to year. We are not here concerned with such choices; instead, we are concerned with "the sum total of all interests that bear upon an occupational career." When over four hundred separate interests are taken into account, we find that there is surprising stability of interests among adults[2] and that, although there are some changes from 15 to 30 years of age, on the whole the general pattern of interests continues throughout life.[3]

Table I illustrates what is meant by a pattern of interests. The average engineer, for example, would dislike to be an actor, advertiser, or artist, is indifferent to being an army officer, but would like to be an architect. The other five occupational groups mentioned in the table have characteristically different patterns of these five occupational items. The six occupational groups differ also with respect to liking and disliking the school subjects they studied. The pattern of interests discussed here is based upon 420 items, not merely upon the ten items given in Table I. As a result of analyzing the interests of men in over thirty occupations we know that each occupational group has a characteristic set of likes and dislikes that differentiates it from other occupational groups.

III

Occupational groups are not, however, all equally different from one another in this respect. The interests of engineers and chemists are nearly alike (correlation corrected for attenuation is .95). Similarly the interests of life insurance and real estate men are nearly identical. Occupations can be grouped according to the interests of the men to be found in the occupations. Such grouping is not based on similarity of activities performed in these occupations, although in the main there is considerable similarity within any group. It is based entirely on the similarity of interests possessed by men in the occupations.

Table II presents the grouping of 28 occupations into five main groups, two of which are subdivided, making seven

[2] E. K. Strong, Jr. *Change of Interests With Age*, Stanford University Press, 1931.

[3] E. K. Strong, Jr. "Interest Maturity," *Personnel Journal*, August, 1933; also forthcoming article in same journal entitled "Classification of Occupations on Basis of Interests."

TABLE I

TYPICAL LIKES (L), INDIFFERENCES (I), AND DISLIKES (D) OF SIX OCCUPATIONAL GROUPS

ITEM	Engineer	Lawyer	Life Insurance Salesman	Minister	Personnel Manager	Accountant
Actor	D	L	D	L	L	I
Advertiser	D	D	L	L	I	I
Architect	L	D	I	L	I	D
Army Officer	I	L	I	D	L	I
Artist	D	D	D	L	I	D
Algebra	L	D	D	I	D	L
Agriculture	I	D	L	L	I	I
Arithmetic	L	D	D	D	L	L
Art	I	D	I	I	I	D
Bible Study	I	L	L	L	I	D

TABLE II

CLASSIFICATION OF OCCUPATIONS IN TERMS OF INTERESTS

Group	Octane[a]	Occupation	Factor Loadings No. 1	No. 2	No. 3	No. 4	No. 5
I	1	Chemist	.561	—.569	.578	.097	.179
I	1	Engineer	.389	—.515	.641	.270	—.052
I	1	Farmer	.320	—.250	.675	.112	—.182
I	1	Mathematician	.561	—.716	.142	—.024	.150
I	1	Physicist	.458	—.754	.404	—.055	.142
I	1	Architect	.574	—.614	.099	—.236	—.617
I	1	Dentist	.486	—.494	.443	—.121	—.248
I	1	Physician	.381	—.793	.062	—.152	—.087
I	1	Carpenter	.400	—.004	.795	—.075	—.171
I	4	Psychologist	.560	—.640	—.056	—.354	.305
I	4	Artist	.140	—.790	—.267	—.324	—.261
IIA	8	Lawyer	—.124	—.279	—.835	.177	.011
IIA	8	Journalist	—.223	—.434	—.785	.029	—.077
IIA	8	Advertiser	—.496	—.169	—.750	.074	—.155
IIB	7	Life insurance salesman	—.429	.625	—.413	.211	—.260
IIB	7	Real estate salesman	—.638	.360	—.315	.426	—.297
IIIA	3	Minister	.530	.236	—.405	—.577	.145
IIIA	3	Teacher	.825	.266	—.156	—.298	.208
IIIA	2	Musician	.437	.079	.089	—.561	—.019
IIIB	3	Personnel manager	.274	.741	—.042	.104	.210
IIIB	3	City school superintendent	.545	.530	—.505	—.066	.203
IIIB	3	Y.M.C.A. secretary	.433	.774	—.240	—.320	—.317
IIIB	2	Y.M.C.A. physical director	.400	.691	.163	—.344	—.035
IV	2	Accountant	.217	.563	.428	.487	.202
IV	2	Office man	.091	.818	.403	.195	—.002
IV	6	Purchasing agent	—.084	.333	.516	.740	—.015
IV	6	Vacuum cleaner salesman	—.109	.896	.205	—.012	—.113
V	3	Certified public accountant	.148	.090	—.261	.493	.380

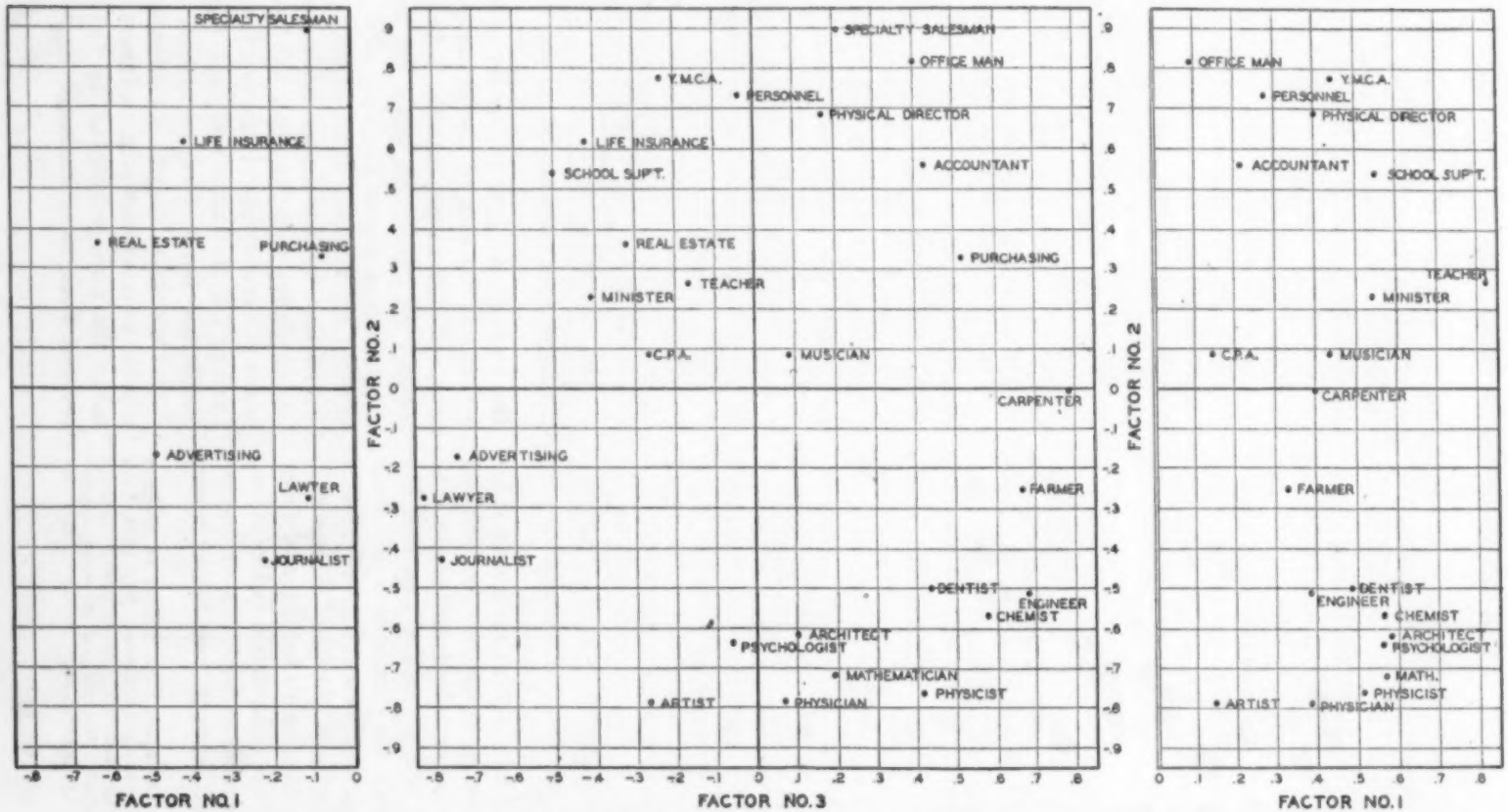
[a] See footnote No. 5 in text.

groups all told. This classification is not to be viewed as complete. As additional occupations are added to the list, the grouping will be modified somewhat, but in the main the classification will probably remain as at present. The basis for such a classification is illustrated in Figure 1.

Using Thurstone's technique of factor analysis,[4] five independent factors are obtained in terms of which the various occupational interests may be expressed. The loadings for these factors are given in Table II for each of the 28 occupations. If the second and third factor loadings are plotted, we obtain the central portion of Figure 1. Thus YMCA secretary has a second factor loading of +.774 and a third factor loading of —.240 placing it in the upper left hand corner of the diagram. If the first factor loadings are also considered, the three coordinates locate each occupation in three-dimensional spaces. To determine whether an occupation is located above or below the plane established by factors two and three, note whether it is given

[4] L. L. Thurstone, "The Theory of Multiple Factors," *Psychological Abstracts*, July, 1933, Entry 3091; L. L. Thurstone, "A Simplified Multiple Factor Method," *Psychological Abstracts*, September, 1933, Entry 4171.

FIGURE 1. GROUPING OF OCCUPATIONS IN TERMS OF THREE FACTORS (THREE DIMENSIONS) SEE EXPLANATION BELOW



The central portion of the figure shows the location of 28 occupations in terms of Factors 2 and 3. The sections to the right and to the left show the location of these occupations with respect to Factor 1. To obtain a three dimensional view imagine the right hand section bent up at right angles to the central portion and the left hand section bent down. The location of specialty salesmen is then —.1 below the central plane, similarly the location of office man is +.1 above the central plane, etc.

The whole diagram pertains to a sphere. Most of the occupations are located not far from the surface of this sphere.

at the extreme right or extreme left of the figure; to determine how far it is above or below the plane, note how far it is located from the right and left edges, respectively, of the central portion of the figure. Thus life insurance is located .433 units below the plane while city school superintendent is .545 units above the plane. Although at first glance these two appear in the central part of Figure 1 to be located very near each other, it is evident that as regards factor one they are .978 units apart. (It is largely for this reason the correlation between the two is only .224.)

These seven groups of occupations may be likened to constellations of stars. Group I is located near the upper surface of a sphere in octane[8] No. 1; Group IIa is near the under surface in octane No. 8; Group IIb is also on the under side of the sphere in octane No. 7. Groups IIIa and IIIb, with the exception of YMCA physical director, are near the upper surface in octane No. 3; Group IV is in octanes 2 and 6; Group V is located not far from the center of the sphere, within octane No. 3.

As five coordinates (factor loadings) are necessary to locate the position of each occupation the true relationships can only be expressed in terms of five-dimensional spaces. As this cannot be shown in a diagram it is necessary to draw several diagrams, similar to Figure 1, giving varying combinations of the five factors. Actually, however, the general relationships between the occupations are shown quite well in Figure 1. This is true because factors four and five are of less significance than the first three factors.

What is the significance of these relationships? Or in other words, of what value is the grouping of occupations as set forth in Table II? As far as interests go, one may expect a man to change from law to journalism or to advertising or *vice versa* since the interests of men in these occupations are closely related, thus:—

	Raw Coefficient	Corrected for Attenuation
Correlation, law and journalism	.81	.88
law and advertising	.69	.77
journalism and advertising	.81	.88

Similarly, the interests of men in farming, engineering, chemistry, dentistry, physics, mathematics, architecture, medicine, and psychology are very much alike. To change from one to another is not at all unusual. But a change from any one of them to law or writing represents a very great change.

Second, with the use of the interest test it is possible to determine in which occupational group a man's interests fall. For vocational guidance in high school and even junior college this determination is usually sufficient and often is preferable to vocational guidance in terms of specific occupations. Thus if a boy believes he is going to be a chemist, it will be much more difficult to interest him in laying a broad foundation for his career than if he believes he will eventually specialize in some one of the sciences but does not know which one. In view of the rapid changes in industrial and professional life it is folly to prepare for a narrow specialty because it may disappear overnight. The young man who spends a portion of his time studying physics, mathematics, and physiology, and consequently less time upon chemistry, is much more likely

[8] If a sphere is trisected by three planes, perpendicular to each other, there result eight segments (octanes). Looking down upon such a sphere there are visible four octanes. These may be referred to by number: No. 1 is the octane to the right toward one; No. 2 is to the right but away from one; No. 3 is to the left and away from one; No. 4 is to the left and toward one. The four octanes underneath may be similarly numbered in counter-clock order so that No. 5 is underneath No. 1; No. 6 is underneath No. 2, etc.

to succeed as a chemist than another who devotes all his time to chemistry.

IV

How permanent are these patterns of interests which are measured by the Vocational Interest Test? The evidence is clear that they are very stable from 25 to 55 years of age. The evidence is also clear that there are real changes from 15 to 30 years of age. To a large degree this is due to the development during later adolescence of interests typical of occupations in Group III (see Table II). Because of this fact 15-year-old boys who will eventually enter teaching, the ministry, and related activities are not likely to select these occupations at that early age, and their interest ratings are likely to be much lower at 15 than at 25 years of age. Although there are these changes, nevertheless interest patterns are really surprisingly stable, as is shown by the high correlations in Table III expressive of permanence of vocational interests for one- and five-year periods.

The conclusion which many have reached that there is little reliability in a boy's declaration that he is going to be an engineer or lawyer is to be accepted, but this does not mean that his interests change without rhyme or reason. The sum total of his interests remains surprisingly constant, as Table III indicates. What does change greatly is the boy's interpretation of his interests in terms of vocational choice. This is to be expected because he is in no position to know the significance of his varied interests or their relationship to occupational activities. It is just here that the Vocational Interest Test has its chief merit, for it interprets one's interests in terms of occupations.

V

After a man's blank has been scored, the numerical scores are expressed by the ratings A, B+, B, B—, and C. A rating of A means the man has the interests of that occupational group; a rating of C means he does not have the interests of the men in that occupation. Ratings of B+, B, and B— are intermediate; they mean he probably has the interests of the occupation, but we cannot be so sure of it as we can when he receives an A rating.[6]

Table IV records the ratings in 17 occupations for seven Stanford University

[6] See *Manual* for further discussion as to the meaning of these ratings. *Manual for Vocational Interest Blank*, by E. K. Strong, Jr., Stanford University Press, Stanford, Calif. Price, 5 cents.

TABLE III

PERMANENCE OF VOCATIONAL INTERESTS FOR ONE- AND FIVE-YEAR PERIODS. SAME INDIVIDUALS TESTED TWICE.

	One year		Five Years	
	11th *vs.* 12th Grade[a]	Freshmen *vs.* Sophomores in College	Seniors in 1927 *vs.* 1932	Same Corrected for Attenuation[b]
Number of cases	100	247	223	223
Engineer scale	.828	.906	.844	.898
Physician scale	.726	.845	.778	.880
Lawyer scale	.652	.753	.769	.857
Minister scale	.678	.786	.643	.702
Average	.721	.822	.759	.834

[a] Internal evidence suggests that a small minority did not take the task of filling out the blank seriously or else that there is surprisingly high permanence of interests at this age for most boys and very little permanency for the remainder.

[b] The average reliability of 27 occupational scales is .878 (odd-even technique).

TABLE IV

INTEREST TEST RATINGS ON 17 OCCUPATIONS FOR SEVEN 1927 COLLEGE SENIORS

Vocational Choice in 1927	Medicine		Engineering			Law	Don't Know
Sure of Choice	Yes	No	Yes	Yes	Yes	Yes	
Code Number	205	214	269	256	225	209	226
Farming	A	C	A	A	C	C	C
Engineering	A	B—	A	B+	B—	C	C
Chemistry	A	B+	A	B	C	C	C
Psychology	B—	B	C	C	C	C	C
Medicine	A	C	C	C	B	C	C
Architecture	C	C	C	C	C	C	C
Law	C	C	C	C	B+	A	C
Journalism	C	C	C	C	B+	B+	B
Advertising	C	C	C	C	C	B—	B—
Life insurance	C	C	C	C	C	C	C
Real estate	C	C	C	C	C	B—	B+
Ministry	C	C	C	C	C	C	C
Teaching	C	B	C	C	C	C	C
Y. M. C. A.	C	C	C	C	C	C	C
Personnel	C	B—	B	C	C	B+	C
Purchasing	B	B	B	B	C	B	B
Public accounting	C	C	C	C	B—	B+	C

Vocational Choice in 1932	Medicine	Chemistry	Engineering	Law	Salesman Steel Products

seniors of the class of 1927. Follow-ups of these men have been made in 1928, 1929, and 1932, so that we know with considerable accuracy what they have done to earn a living since graduation. No. 205 reported on the first three occasions that he was planning to go into medicine, a decision he says he made in 1921. Prior to that time he had considered civil engineering. In 1932 he was practicing surgery in a hospital. His interest ratings are A in farming, engineering, chemistry, and medicine. His vocation today is in harmony with his interests in 1927.

No. 214 did not know in 1927 what he was going to do (his major had been chemistry); in 1928 he was sure of medicine as his choice; in 1929 he was working for an M.A., in education in order to earn money by teaching to attend a medical school and reported he was fairly certain the latter course was the proper one for him. In 1932 he had a position as a chemist with which he was "pretty content"; at the same time he suggested he might return to college and "study medicine, biochemistry, or bacteriology." According to the interest test in 1927 his strongest interest was chemistry with psychology, teaching, and purchasing next. In medicine he rated C.

No. 269 is a typical civil engineering student who had planned on this career since 1921. In addition he had daydreams of ranching and architecture. His present position in engineering is in agreement with his interests as determined in 1927. No. 256 had also planned for some time to be an electrical engineer and is engaged in radio engineering today. According to his 1927 interests farming should be his first choice and engineering second. No. 225, on the other hand, has alternated between mining, engineering, and law, preferring

the latter in 1928. But in 1929 he had switched back to mining. In 1932 he had a position as a mining engineer. He reported in 1928 and 1929 that he was studying English and writing. The interest ratings of B+ in journalism and law and only B— in engineering suggest that his avocation of writing articles and stories may supplant his present vocation. A further follow-up in 1937 will possibly settle the question as to the potency of early interests in determining this man's career.

In 1915 No. 209 was planning to enter law; in 1924 his aim was the brokerage business; in 1926 and 1927, banking; and in 1928 and 1929 and also 1932, law, in which he is now engaged and which he considers is his final choice. The interest ratings of 1927 agree with his final decision.

No. 226 reported in 1927, 1928, and 1929 he did not know what he was going to do. In 1932 he was engaged in selling steel products to farmers. His interest ratings are not very helpful, suggesting selling real estate and to a lesser degree purchasing and journalism.

Some men have very broad interests so that they rate A or B in five to ten occupations belonging to two or more occupational groups. This seems to be fairly typical of the records secured from men of national reputation whether they are engaged in a profession or in business. Others have fairly broad interests but largely or entirely restricted to one occupational group. No. 205 in Table IV is typical. On the other hand, there are men who rate A or B in only one occupation. Generally speaking these men are known as extreme specialists.

The men who don't know what they are going to be while in high school or college fall into three groups. First, there are those who rate high in two or more unrelated occupations as law and engineering, or accounting and the ministry. It is easy to see why they find it difficult to decide. Second, there are men who rate low in practically all occupations. No. 226 is a fair example of this type, although he is better off than some since he has a B+ and a B rating. Third, there are some whose ratings are similar to those who early make up their minds. Why they don't do likewise is a mystery.

Ratings from the Vocational Interest Test should be viewed as suggestive and to be considered in the light of all other information bearing upon one's vocational choice. Occupations rated B—, B+, or A should be carefully considered before definitely deciding against them; occupations rated B— and C should be equally carefully considered before definitely deciding to enter them.

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UNITY OR PURITY IN TRAITS AND TESTS

EDWARD L. THORNDIKE

AMONG some scientific students of educational and vocational guidance there is now a strong demand for tests, records, ratings, or other instruments which will give measurements that are unitary or pure in the sense that whatever is measured by the test, rating, etc., is homogeneous, all of one piece, not a compound of two or more things which could as well, or better, be measured separately. It is desired that tests or ratings which are hybrids or compounds be so, not by our inadvertence, but by our intent in putting together known units with known weights. It is the purpose of this article to state a few of the procedures and precautions which are desirable in the work of selecting or constructing such tests.

In the psychology of individual differences we have been accustomed to think in terms of abilities and traits or tendencies, such as the ability to read French, the ability to play the violin, the ability to tap rapidly, the trait of honesty with property, the trait of honesty in examinations, the trait of honesty in games, the trait of introversion, the trait of craving mastery or dominance, the tendency to suffer manic-depressive insanity, the tendency to hysteria, the tendency to like society, the tendency to bite one's fingernails, and so on through a long list.

Unless we know of some reason to the contrary, we tend to assume that the trait is unitary. But in strictness we should never assume this. In strictness this list should be broken up into an enormously longer list in which the correlations would be perfect within any ability or trait. A statement that an individual possesses such and such an amount of an ability or trait or tendency is actually a statement that he has responded in certain ways to certain situations or elements of situations and constitutes a prophecy that he will do so in the future under similar conditions. Such a statement about one trait may thus be a general average or summary of particular abilities, habits, wants, attitudes, interests. If these do not correlate perfectly they should not in strictness be attributed to a single unitary trait.

In practice, however, if the intercorrelations among a set of particular abilities, attitudes, etc., are very high, so that the community of causation very greatly outweighs the diversities, the latter may be neglected. In particular, diversities due to errors of measurement or to changes in conditions which are irrelevant to the qualities of persons should be neglected.

The prudent practice of averaging particular abilities, attitudes, etc., in spite of known diversities, and treating the result as the measure of a unitary trait, should not confuse us into treating as the measure of a unitary trait an average or summary score representing particular abilities, attitudes, etc., whose intercorrelations we do not know. This is especially true if what we do know about them suggests that they are far from perfect. Such average or summary scores are very valuable; they may be of notable service

in distinguishing individuals and in predicting important facts. But they may not be measures of unitary traits; it may be misleading to call them by single names; it may be unwise to think of a person as having qualities corresponding to them. Some of the particulars within such an alleged trait, say musical ability, may correlate more highly with some of the particulars outside of it and inside of some other alleged trait than with some of those within it. The search for causes may be directed very differently, if the score is a summary or average of particulars with low intercorrelations, from the way chosen if the score is a measure of particulars with substantially perfect intercorrelations. For the former we must expect to find several causes; for the latter we shall often hope to find one cause or factor, variations in whose amount account for the variance among individuals.

II

An ability or trait that is unitary to ordinary observation may have a composite causation, and a very definite and unitary cause may, under different conditions (i.e., in cooperation with other causes), be hidden in many very diverse abilities or traits as observed and scored. Thus the ability in the running high jump—as measured by the total score in jumping over oak bars, pine bars, metal rods, wires, fences, and hurdles, indoors and out, morning, afternoon, and evening, with clothes on and without, before spectators and alone, in competition and in practice—would probably show rather high intercorrelations in, say, a thousand male 25-year-olds chosen at random and practiced until each reached his limit. It would be a fairly unitary ability. But the causation of its unity might include the status of many muscles, various actions of the brain in timing and coordinating, and special physiological processes for releasing energy. On the other hand, the presence of the micro-organism of syphilis is a highly unitary cause, with a rather simple variation in influence according to the virulence of the specimens, which nevertheless may under different conditions share in many traits of body and mind.

An important case in mental measurement is where we use a score which we know or think is a total due to community plus diversity of a peculiar sort, namely, such that the elements or components producing the diversity are entirely independent or disparate or mutually exclusive in the sense that any one of them will correlate zero with any other. This case has been emphasized by Spearman in describing a common factor as a partial cause of the correlations between scores in a number of rather "large" traits, the rest of the causation being contributed by specific factors no two of which have any community. We are here concerned with it in the case of rather "small" traits such as ability to add integers, or speed in running 100 yards, or fondness for sweet tastes, or ability to distinguish red from green.

If the intercorrelations of various tests of a trait, say, the ability to add integers, can be explained by one common factor plus such specifics, and if the contribution of the common factor is very large compared with that of any of the specifics, it may be desirable to neglect the specifics, and consider the common factor alone.[1] The total score of a considerable number of such tests will be a measure of the

[1] The subject is, of course, restricted to the work with the trait in question. It is highly undesirable to neglect them in toto. Being born of rich parents may be a trivial specific in respect to the addition of integers, but an important group factor in the case of twenty tests of knowledge of social customs and ability at games, and perhaps an important common factor in a dozen tests of prejudice in favor of capitalism.

common factor alone, to a very close approximation. The mere existence of a common factor is not a sufficient justification. If it contributes little, accounts for little of the variance, some of the specifics may be more important than it for analysis, prediction, causation, or other purposes. For historical reasons discussions of such specific factors have been concerned chiefly with their presence. But in the actual work of mapping the mind, their magnitude in comparison with the common factor is of great importance.

Unless one is familiar with recent work in mental measurements one is likely to overestimate the contributions from common factors in comparison with those from specific, group, or overlapping factors. The expert psychology of the past and the popular psychology of the present use freely words like attention, memory, imagination, judgment, reasoning, musical ability, artistic ability, mathematical ability, honesty, patience, courage, and leadership. The use of such words tempts us to think that there are unitary cores or strands or features of behavior corresponding to the word, and that these account for the great bulk of the variance among individuals. On the contrary, the expectation from actual measurements is that the web of life is not constructed from a score or so of large unitary stripes in warp and woof plus some thousands of very minor threads, and adventitious tags and fragments. The safe procedure is not to assume what the total score of a group of tests or items measures but to observe their intercorrelations.

III

The work of selecting or constructing tests which will be "unitary" or "pure" in our sense is beset with other difficulties which cannot be described here. Neither is there space to estimate the probable benefits, assuming that enough is known to justify such an estimate. It may turn out that present methods of using what seem promising groups of symptoms of some important fraction of man, determining the validity of the resulting scores for various descriptions and prophecies, using them in regression equations, and analyzing them *ex post facto* by the analyses of Spearman, Kelley, Thurstone, Hotelling and others may continue to be the most profitable line of attack. One of the "factors" or "components" located by these analyses has the great merit of correlating zero with all other factors of the analyzed variance. This independence may be a more valuable asset than the purity we have been discussing. Moreover, traits which correlate zero with others are likely often to be pure, so that it may be wise to construct any pure test by selection from elements which a factor-analysis suggests are due entirely to one independent factor or component. On the other hand, it may be argued that pure tests are likely often to be due to independent factors or components, and that if we can use them from the beginning, the regression equations may be simpler and the analyses into factors may be more illuminating.

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APTITUDE TESTING

Its Contribution to Vocational Guidance

HARRY DEXTER KITSON

WHAT practical contribution can aptitude testing make to vocational guidance? Before this question is discussed, a distinction should be made between two terms which are often confounded—"ability" and "aptitude." "Ability" should be used to designate a specific skill which has been acquired through training or experience, for example, skill in taking shorthand. "Aptitude" should be used to designate the readiness with which an untrained person acquires a given skill. Thus the Gregg Stenographic Speed Test would be classed as an ability test, since it was devised to measure the degree of skill possessed by stenographers, while a test designed to select persons who might profitably take a course in stenography would be classed as an aptitude test.[1] It is tests of the latter sort that we shall discuss in this paper.

No one knows the origin of vocational aptitudes. One view seems to be that they are born within the individual. Thus we hear that this or that person is a "born" inventor, actor, salesman, or aviator; that "poets are born, not made"; that a book was recently entitled, *Born That Way*. From all that is known about the hereditary nature of man, scientists are not inclined to admit the existence of ready-made vocational aptitudes. The evidence seems rather to support the view that environmental factors play a large part in conditioning an individual toward successful adjustment in certain occupations. In view of this fact, most psychologists regard aptitudes as existing phenomena regardless of their origin, and try to devise tests for them. The matter really deserves more attention than is here allotted to it, for on one's theory regarding aptitude hinge important questions—the legitimacy of prediction as a technique of vocational guidance and selection, the possibilities of training, the influence of motivation, etc. Due to exigencies of space, however, we must omit further discussion and proceed to the practical question posed at the beginning of this article.

The vocational counselor who wishes to use the most up-to-date techniques is confused by the large number of tests which purport to measure various aptitudes. They cover a wide range of occupations, from power-machine operator to that of technical engineer. Even for the same occupation, as many as three or four different tests have been invented by different persons, and the perplexed counselor asks, "Which one shall I use? Indeed, are any of them suitable for practical use?" In this paper we shall present the considerations that must be taken into account in judging the value of an aptitude test.

II

Necessity for testing a test. It is easy enough to invent a test and label it "A Test for Salesmen," but before it is ap-

[1] *Employment Psychology*, Burtt, H. E. Boston, Houghton Mifflin, 1926. Pp. 62.

plied in a practical situation it should be *proven* to be a test for salesmen. The technique for establishing this proof is highly complicated and exacting. The test must be given to a group of persons in the occupation (preferably 100 or more), whose proficiency is known so well that they can be reliably arranged in order from highest to lowest, or at any rate, grouped in several grades such as Superior, Good, Average, Fair, Poor. The scores made on the test should, if the test is valid, rank the individuals in the same way as they were ranked according to their occupational proficiency.

There is one objection to this plan of testing persons who are already proficient in the occupation. By reason of their training and experience they have become non-representative of the type of persons for whom the test has been devised—namely, persons who have had no experience in the occupation. In order to overcome this objection another plan has been used by some investigators: that of testing applicants for work and hiring them regardless of the scores they made on the test; then observing the readiness with which they acquire the necessary skill and the degree of proficiency which they eventually develop. One of the infrequent examples of this procedure was furnished by Johnson O'Connor at the Lynn Plant of the General Electric Company.[2]

Difficulty of measuring occupational proficiency. One of the first obstacles encountered in following either of these procedures is that of determining units with which to denote the degrees of skill of the workers tested. In the case of salesmen, for instance, it is not fair to use number of sales, nor gross amount of sales, nor amount of commission. Bingham and Freyd list 13 different types of criteria which may be employed, but it is admitted that no single one is fair and there is no known way of combining several into a satisfactory measure.[3] Failing in finding desirable objective criteria, most investigators have contented themselves with using ratings supplied by foremen or supervisors. These are, however, notoriously unfair, being colored by prejudice, whim, and insufficiency of acquaintance. The impossibility of obtaining an equitable basis for establishing degrees of proficiency would be enough to cast adoubt on aptitude tests all apart from other limitations which will presently be discussed.

A perplexing circumstance is that even after a test is standardized it can legitimately be used only with the type of persons to whom it was originally given. Thus a test which was standardized in terms of a group of automobile salesmen in New York City could not properly be used in selecting or guiding salesmen of footwear or even automobile salesmen in Dallas.

Establishing validity. But to proceed with the steps which must be taken in proving that a test is valid: After the subjects are ranked as well as possible according to vocational proficiency and according to the scores made on the test, it is necessary to relate these rankings to each other. There are various ways of doing this. One is to establish a critical score. For example, in the following table, an employment manager might have determined that he would not ac-

[2] Johnson O'Connor, *Born That Way.* Baltimore, Williams and Wilkins, 1928.

[3] W. V. Bingham and M. Freyd, *Procedures in Employment Psychology.* New York, McGraw-Hill, 1926. Chap. III. See also R. M. Elliott, L. D. Anderson, H. A. Toops, and E. Heidbreder, *Minnesota Mechanical Ability Tests,* Minneapolis, University of Minnesota Press, 1930. Chapter IX.

TABLE I

SAMPLE ARRANGEMENT OF 50 WORKERS ACCORDING TO OCCUPATIONAL PROFICIENCY AND SCORES ON TEST

Individual	Unit of Work	Score on Test	Individual	Unit of Work	Score on Test
A	110	95	AC	64	59
B	108	94	AD	62	57
C	106	92	AE	60	53
D	105	90	AF	59	56
E	104	91	AG	58	52
F	102	87	AH	57	54
G	100	84	AI	57	50
H	98	88	AJ	56	48
I	96	86	AK	56	51
J	95	90	AL	56	49
K	94	88	AM	55	53
L	92	85	AN	55	48
M	90	81	AO	55	54
N	87	88	AP	55	47
O	86	82	AQ	55	55
P	85	76	AR	54	50
Q	83	79	AS	54	47
R	81	84	AT	52	41
S	80	81	AU	52	48
T	78	76	AV	50	44
U	77	71	AW	50	41
V	75	74	AX	49	42
W	74	70	AY	48	43
X	72	68	AZ	47	40
Y	70	67	BA	46	37
Z	68	63	BB	45	40
AA	67	66	BC	44	39
AB	65	62	BD	42	38
			BE	40	35

cept any one for a certain job who could not produce at least 92 units of work.

By inspecting column 2 we see that to find such persons he would have to set a critical score on the test above 84, since that is the lowest score made by any one (Individual G) in the "satisfactory" group. In using this score the employer would be hiring two persons (Individuals N and R) who would not reach the required output of 92 units, but in all other cases the test would constitute a good selective instrument.

This technique, which can be applied at the lower end as well as the upper end of the scale, lends itself particularly well to vocational selection—that is, the selection of employes in a business establishment—or to the admission of students in an educational institution.

Another technique, which has been more widely used in determining the validity of an aptitude test, seeks to determine the relationship between proficiency and test-score in terms of an index of correlation. If this is .75 or above the test is generally considered to be useful. But few of the aptitude tests on the market meet this requirement.

Reliability. Another factor which should be determined regarding any proposed aptitude test is its reliability. By

this is meant the consistency with which the test operates. Two methods are commonly used for determining this. One is to use alternate items of the test and determine if the individuals taking the test stand in relatively the same positions on both sets of items. Another is to give the test twice and see if the standings are the same both times. The latter method is not advisable, since the experience of taking the test once is likely to affect performance on it a second time. Indeed, strictly speaking, the second test becomes a different test from the first, for the "mental set" of the subject becomes different. James stated this phenomenon as follows: "No state once gone can recur and be identical with what it was before. . . . Every thought we have . . . is, strictly speaking, unique. . . . When the identical fact recurs we *must* think of it in a fresh manner . . . apprehending it in different relations from those in which it last appeared."[4]

Regardless of the way in which the reliability is determined a correlation should be computed showing the reliability. This should be around .95. When we examine the indices of reliability reported in connection with aptitude tests we find that few of them approach the desired figure. Indeed, many investigators have not even taken the trouble to compute the reliability.

With every index of correlation should go a measure of the dispersion, usually expressed in terms of probable error or sigma. Many inventors of tests fail to give such a figure. The figure, whatever it is, is a function of the number of subjects to whom the test was originally given. As was said in a preceding paragraph, the number of subjects should be at least 100, but many inventors of aptitude tests have used much smaller groups.

III

Is prediction possible? In the literature on aptitude testing the point is often made of the desirability of predicting the vocational success of an individual.[5] With respect to this point it should be noted that prediction from massed statistics can not be made in terms of an individual. At best the individual could only be said to possess the aptitude necessary for success in a given occupation. Whether or not he would *use* that aptitude in future years could never be predicted. In vocational guidance, at least, aptitude tests can not tell fortunes.

Another observation we should make is that aptitude testing is more useful in vocational selection than in vocational guidance. In the former case we wish to select, from a number of applicants, the one who is likely to do the best work on a particular job. In this undertaking, aptitude tests, even some of the faulty ones now on the market, have been reasonably useful. But in vocational guidance, that is, in trying to help an individual to choose a vocation, aptitude tests, even perfect ones, will probably not be of much practical value, for even though an individual might have the aptitude discovered by the test, he would probably have a number of others. So variable are human capacities that it is probable that 50 per cent of the population could succeed, with a 50 per cent degree of success, in 50 per cent of the occupations. It would surely be impracticable to try to test every individual for all of the several thousand occupations.

Indeed, one might well question whether the concept of "vocational apti-

[4] William James, *Psychology, Briefer Course.* New York, Henry Holt, 1893, p. 154.

[5] C. L. Hull, *Aptitude Testing.* New York, World Book Co., 1928. Chap. XIV.

tude" is legitimate. Surely if by it we mean a psychological entity, we should seriously doubt its very existence.[6] Under any circumstances, the evidence strongly favors the view that a vocational aptitude, if it exists at all, is not a unitary trait but rather a collection of traits. Thus Seashore conceives of musical talent not as a unit, but as a group of traits such as sensitivity to pitch, sensitivity to rhythm, etc. The authors of *Minnesota Mechanical Ability Tests,* already referred to, found no evidence to support the view of mechanical aptitude as a general factor, they rather upheld the idea that it is made up of a number of specific factors.

In spite of the severe strictures here recounted, it is probable that psychologists will continue to devise aptitude tests and that an eager and gullible public will continue to use them. Two warnings should, at any rate, be heeded: First, all experimentation should be left to well-trained psychologists. The technical difficulties involved are so great that no one else can be expected to steer a safe course. Second, it is generally recommended that instead of spending their time devising new tests, pyschologists had better test the tests already available and determine their vocational significance. If this advice is heeded, the years to come may see less emphasis placed on the efficacy of psychological tests, and more attention paid to other techniques which are likely to yield better results in practical vocational guidance.

[6] H. D. Kitson, "Does General Mechanical Aptitude Exist?", *Industrial Arts and Vocational Education,* June, 1930. Pp. 215-219.

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WANTED: A TITLE

The NOC bibliography of occupational information, prepared by Willard E. Parker and described in the October issue of this magazine, will shortly be published for NOC by the American Library Association. This bibliography comprises about 9,000 titles relating to more than 500 occupations.

Who can suggest an appropriate and effective title for the book? Write to National Occupational Conference, 522 Fifth Avenue, New York City.

APTITUDE TEST BATTERIES

Procedures in Their Construction

CLARK L. HULL

EXCEPT for very unusual individuals, every person has a certain amount of potential aptitude for the performance of every possible vocation. Probably in no two aptitudes, however, does a given person have equal potentialities. There is convincing reason to believe that the distribution of abilities of any person for the performance of the various possible vocations distributes itself very much according to the "normal law"; that is to say, the most of each person's potential abilities probably group themselves rather closely around some central tendency, but a good many of them scatter off in decreasing numbers in each direction, a few of them representing very low abilities and a few, very superior abilities. It is one of the functions of a scientific vocational guidance to ascertain in which aptitude of each person these relatively superior abilities lie, to the end that he may choose these for his life work rather than vocations which lie at the opposite extreme of his abilities. It is the function of aptitude tests to aid the vocational counselor in the discovery of these latent maximal potentialities.

II

Psychological tests are of many kinds. For the most part they are samples of behavior which have been found to be related in some way to abilities to perform the work of socially valuable occupations. The most certain way to determine whether a person has a given vocational aptitude is to put him in the vocation and try him out. Unfortunately this mode of procedure often takes the good share of a lifetime, so that as a means of vocational guidance it is valueless. The use of psychological tests at the present time lies not so much in their high precision of predictive value as in the fact that considering what predictive value they have, the cost of time and effort is relatively slight. Most aptitude tests in current use may be administered in two or three hours.

Experience has shown that vocational aptitudes are usually very complex. Success in them depends upon so many different abilities that single psychological tests are almost never adequate to yield a useful prognosis. As a result, it has been found necessary in practically all cases to combine a number of tests for this purpose. Such a combination of tests is called an *aptitude test battery*. The construction of useful aptitude test batteries is a task requiring considerable labor and technical skill, and is usually not a job for an amateur. It is desirable, however, for vocational counselors and others who would use aptitude tests intelligently to know something of how they are constructed, and how their actual utility is determined.

The procedure of doing this may be briefly summarized under seven headings or steps, which are as follow:—

(1) The psychological analysis of the vocation.

(2) The choice of a preliminary battery of tests.

(3) The administration of the preliminary battery to a group of individuals whose actual abilities on the aptitude in question may be measured.

(4) The determination of the actual aptitude of the individuals in the trial group.

(5) The comparison of the test scores with the actual abilities of the subjects on the aptitude and the rejection of all tests thus found to be useless.

(6) The combination of the tests found to be valuable into a battery which will yield a prognosis of the aptitude on individuals whose aptitude is not otherwise known.

(7) The administration of the aptitude battery thus constructed to a second group of subjects whose ability in the aptitude can be measured, to the end that a determination may be made of exactly how accurately the test battery as a whole is able to predict this aptitude.

III

The first step in the construction of aptitude test batteries is the analysis of occupational behavior. One of the best preliminary steps is for the investigator actually to work at the task for a few days or weeks. On a simple level this analysis consists merely of an attentive observation of a person engaged in the vocation; this should result in an explicit statement of all the part-activities which the worker actually performs. This is known as the *job analysis*. If time permits, this analysis should be continued by determining in which of the part-activities of the job the persons recognized as superior excel those who are recognized as being inferior, and in which there is little or no difference; the latter are discarded from further consideration. The third part of the process is an attempt to discover for the former part-activities what traits of intelligence, capacity, temperament, will, etc., combine to produce efficiency in them.

The second step in the construction of an aptitude test battery,—the assembling of a trial battery of tests,—requires for its effective conduct a very wide knowledge of psychological tests. During the last twenty years an enormous number and variety of tests have been devised and reported. Many of these may now be purchased from various publishing houses and apparatus companies. The more common forms of psychological tests are those made up mainly of verbal material, such as the familiar Binet tests, Army Alpha, etc. Many of the pencil-and-paper tests are especially economical in use because a large number of people may be given such tests simultaneously by a single trained experimenter. Apparatus tests are often very useful also, particularly those which duplicate the more important part-activities of the vocation in miniature, though they suffer from being expensive both to purchase and to administer. The well-known Stenquist mechanical assembling test is an example of such a test.

The third step in the process of aptitude test construction is the administration of the preliminary test battery to a trial group of subjects. Ideally there should be at least fifty or sixty of these individuals. They should be persons, if possible, who have not yet been trained in the vocation, but who will be so trained subsequently and under conditions such that the actual success of the training can be determined with some precision. In the giving of these tests it is of the utmost importance that active cooperation should be secured from the persons tested. If this cannot be obtained the experiment might about as well be abandoned.

The fourth step is the determination

of the actual aptitudes of the trial subjects. Ideally, after the tests have been given, the subjects go through their training for the aptitude in question. For many important aptitudes often as much as a year of intensive training should follow the testing, and for some, such as the professions, this may extend to a number of years. At the end of the training period some measure must be found of the proficiency to which each individual has attained. This step of the process is by all odds the most difficult of the seven. The reason is that for the most part we have no adequate scales with which to measure such abilities. For example, in what units shall we measure the difference between the artistic value of a child's drawing in comparison with one of the incomparable cartoons of Leonardo da Vinci? In what units shall we determine the extent of the difference between the violin music produced by an ordinary jazz musician and that by Fritz Kreisler? At first sight it would seem quite impossible to give a quantitative determination of such differences, even though everyone is keenly aware that they exist in large amounts. The situation, while difficult, is not by any means hopeless. During recent years, experimentalists and statisticians in collaboration have devised adroit means whereby quite astonishingly effective quantitative determinations can be made of such intangible variables. Among the basic devices employed for this purpose are those of having the subject's performance ranked by experienced judges and the use of various forms of rating scale.

IV

The fifth step in the development of an aptitude test battery is the selection of the final aptitude battery from the group of tests administered to the trial group of subjects. As a rule no more than one-half or one-third of the tests which seem promising for an aptitude turn out really to be so. For this reason a dozen or fifteen tests should usually be employed in the preliminary trial if as many as five really useful tests are desired for the final battery. The basis for deciding whether a given test will be retained in the final battery is whether or not in combination with other tests it will contribute materially to the accuracy of estimating a subject's aptitude. The main consideration in this connection, but by no means the only one, is whether the scores on the test correlate strongly with the scores on the aptitude. The means of determining the extent of such agreements is a statistical procedure known as correlation. In general, tests which correlate very little with the aptitude are bad tests and are summarily rejected. But the mere fact of correlating well with the criterion does not make a test valuable in a battery; if two tests correlate very highly with each other this means that both test the same function, and since it is a waste of time to test a given function more than once, one of two such tests would also be rejected.

The sixth step in the construction of an aptitude test battery consists in devising a method whereby the scores from the several tests of the battery may be combined in such a way as to predict the aptitude score with the greatest possible degree of accuracy. There are numerous ways of doing this, some very simple and some fairly complicated. Many aptitude tests require mere adding up of the gross scores. This, however, is not a very adequate method. The reason is that often one test will be of very much greater significance for the vocation than another test, and should therefore receive correspondingly greater weight in the final prognosis or prediction. Unfortunately,

the assignment of weights in a complex battery of tests is not a matter which can be achieved by mere inspection of the experimental results. The most effective means for determining these weights, and in general of deriving an adequate forecasting formula for a battery of aptitude tests, is the multiple regression technique. This is somewhat complicated, but the outcome is fairly simple. It yields a simple formula, the values of which are to be multiplied by the respective test scores of any given individual; when the products are added up, there results a prediction in terms of the ordinary score on the aptitude.

The seventh and final stage of the preparation of a battery of aptitude tests consists in applying the tests to an entirely new group of individuals who are constituted substantially like those of the trial group. Exactly as in the case with the trial group, the tests should be administered to the subjects before they have had the training for the aptitude. When the aptitude training is completed, a careful determination must be made of the actual attainments of each individual, after which the aptitude predictions based on the test scores are compared (correlated) with the actual aptitudes of the subjects. This procedure is known as *validation*. If a battery yields a correlation of .50 or better, and does not require too long to administer, it may be said to have some significance as a vocational guidance instrument. Some of the better aptitude tests, particularly those of scholastic aptitude, are said to have reached correlations as high as .70 and even higher. Such tests may be considered to have considerable value. In general, tests which are advertised for sale for purposes of aptitude prognosis, but which have not been validated in some such manner as here described, should not be purchased unless definitely for the purpose of research. If the purchasing public would go on a buyer's strike and steadfastly refuse to purchase aptitude tests until they have been validated and the validity coefficients clearly stated, it would have a wholesome effect on the construction of aptitude tests, and the purchasing public would save considerable sums of money.

V

What are the future developments in this field likely to be? This may best be appreciated by contrasting it with what should logically take place at present if adequate tests existed. The problem of vocational guidance is to be able to tell each youth seeking a life work which of the many occupations in the world he is best endowed to pursue. It is likely that there are as many as fifty important type occupations available to many young persons. If adequate tests existed for forecasting aptitude in each of these vocations, the only way to determine the aptitude of maximal potentiality for a given youth would be to administer all fifty test batteries to him. This alone might require a month of a youth's time, to say nothing of the time of an expert examiner. Such a procedure would be quite unnecessarily wasteful, because the different test batteries would certainly involve an immense number of duplicated tests. The cure for this tremendous waste, as well as numerous other defects of the present procedures, would be to administer a single large battery of tests which would give a judicious sampling of the entire spectrum of human abilities but without duplication. Such an aggregation of tests might appropriately be called a *universal aptitude battery*. Once the results from such a battery were available, the scores of those tests which combine

to make the best aptitude forecast for each particular vocation could be combined, and the aptitude forecast made separately for each of the numerous vocations one after another.

For several years there has been in existence a machine which, when given the test scores and the forecasting formulas in the form of perforated paper tapes, is able to make aptitude forecasts automatically. With a little modification this machine could be made to record in a column on a card, like an adding machine, the aptitudes thus calculated, each opposite the name of the vocation in question. The card of forecasts, when removed from the machine, would then present in orderly array, in units of a single uniform scale permitting of instant comparison, forecasts of the individual's probable success in all the chief type occupations. The vocational adviser could then examine the card to learn those vocations in which the youth's chance of success is least. These would be summarily discarded. The counselor could then examine the card to learn those vocations in which, other things being equal, the chance of success is most likely. The three or four most promising vocations thus emerging might then be given special consideration, and from these, in the light of the youth's interest, opportunities, and general circumstances, an intelligent choice of a life work might be made.

What would not vocational counselors give if such information were really available! Many signs indicate the probability that before many years something approaching this ideal will actually be realized. Technical experts in this field are rapidly reaching a point in the knowledge of human nature on one hand, and of experimental and statistical methods on the other, such that a direct frontal attack on this immense problem may be expected to be feasible. The task of bringing it about, however, will be a tremendous one. It is clearly quite beyond the possible attainment of any one individual. On the other hand, it requires such a close integration of effort on the part of many workers that it must be carried out under some single central direction. This means that in all probability the plan will be realized only through substantial subsidy either from the government or some of the research foundations. Meanwhile the date of its accomplishment will be materially hastened by an insistent demand on the part of vocational counselors and those vitally interested in the vocational guidance movement.

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THE PSYCHOLOGICAL EXAMINATION

Its Place in Vocational Guidance

FRANK M. EARLE

THE SCIENCE of Applied Psychology can give to the vocational counselor aid which is of great interest and importance at the present time. From the broadest point of view, *any* study of the behavior of a human being which leads to a better knowledge of his interests, his temperament, his intellectual capacity, or his special aptitudes[1] is a piece of practical psychology, even though the terms in which it is expressed may resemble very little the technical phraseology of the professional psychologist. Whence it is a reasonable conclusion that, insofar as such a study enables an adviser to suggest a material environment or a spiritual atmosphere most appropriate for the individual's further development (vocationally, educationally, or socially) it cannot fail to contribute to a better solution of that individual's problem.

The real point at issue is not whether this study shall be a psychological one—it cannot possibly escape being that—but whether it shall be a systematic or a haphazard one, and what form or forms it shall take. Unless the observations which constitute part of the psychological study of an individual are reliable (i.e., sufficiently near to the truth to warrant belief in them), and appropriate (i.e., concerned with those elements in the individual's mental and physical make-up which actively influence his methods and power of adapting himself to his varied environment), they can contribute little to that fuller understanding upon which all sound advising must ultimately depend. The mere amassing of information can have no value in itself; moreover, too much detail may be as embarrassing as too little. The relevant must be skilfully selected from the irrelevant, and this requires a full and accurate knowledge of the methods and results of scientific investigation in this special field.

In this sense, as well as in regard to the actual steps of procedure, any psychological study must be systematic; for it is evident that collections of casual observations or of prejudiced opinions can seldom provide satisfactory data for sound advising. In vocational guidance in particular the use of scientific methods means a careful attempt to evaluate just those abilities and character qualities of the individual which will have a bearing upon his *vocational* success. In the course of such studies information bearing upon other phases of his active life may be obtained, but these are relevant to our problem only to the extent that they involve vocational issues. Obviously some of them, such as the educational and the social, are so closely linked with the vocational adjustment of the individual that they cannot be isolated from it. This, however, only means that the vocational adviser must not too narrowly restrict the scope of his investigations; and, although the kind of data he collects may thus be-

[1] This order is not necessarily an order of preference or importance.

come widely varied, the method of its collection and interpretation must remain as constant as possible.

II

The idea of studying the individual in a *scientific* way is not exactly new; yet, by reasonably exact standards, achievements up to the present have not been very impressive. This is partly due, I think, to our failure to realize sufficiently the great complexity of the problems of vocational guidance. In seeking a non-existent "short cut" we have often been tempted to depend too much upon information derived from a restricted field of inquiry, neglecting other perhaps equally valuable sources. Those examination devices called "psychological tests," which are now so popular, have gained a place of importance because it was hoped that their use would render superfluous other more laborious or less reliable methods of investigation. But we cannot honestly say that this is yet the case. Valuable though these tests undoubtedly are, they have not yet reached such a pitch of validity and reliability as to supplant other sources of information.

Even if they can be developed to such a degree of usefulness, it remains doubtful whether vocational guidance should become the "rule-of-thumb" procedure which their sole use would imply. There have been proposals for the construction of forecasting machines, uncanny inventions into which are to be fed the individual's scores in a "battery" of tests, and from which will emerge a typed slip showing the special aptitudes of the individual disclosed by the tests. Personally I think that such a device—labor-saving though it be—is not likely to achieve our main purpose, for if there is one essential element in any advising procedure, it is the personal contact between the counselor and the counseled. Remove the "psychology" from the "psychological test" and what have you left?

Many tests are said to be "fool-proof" in their application, but I know of none which are "fool-proof" in their interpretation, because the psychological situation to which the individual has responded during the test has been partly created by himself, has been affected by his "personality," and has therefore become different from the situation in which previously tested individuals found themselves. True, there are many common elements in all these situations; and, in general, the common elements no doubt predominate,—for only so can a test have any diagnostic value. But the *possibility* of error in the result must be ever present in the mind of the observer, and he must use considerable skill and experience in summarizing his observations into a true expression of the individual he has observed.

For this reason vocational guidance should be based upon "psychological examinations" rather than tests, though the latter have their place. The interview, the temperament-rating, the questionaire (to be filled in by the person to be advised), and the like, are all devices which may contribute usefully to the final result, and so may form part of the complete psychological examination of the individual. But these devices express only the form and content, the apparatus and the method, of the inquiry; the interpretation of the results still remains, and it will be apparent that the keener the psychological analysis and the more numerous the aspects of the behavior of the individual it has embraced, the better is this interpretation likely to be.

Vocational advisers may be wholeheartedly in agreement with this prin-

ciple, but may be compelled through lack of time to apply it very little in their practical work. Hence the question of the adequacy of a psychological examination is of considerable practical importance. What is the most effective type of examination? When and where should it be given?

As yet only provisional answers may be made to questions such as these. As we learn more of the relations between the aptitudes and the achievements of individuals, between measures of abilities and occupational success, between qualities of temperament and character and achievement, we shall slowly but surely improve our vocational advising. The counsel we are able to give now is certainly better than it was five or ten years ago, and we may reasonably hope for progressive improvement as our technique of examination is perfected.

III

Recent vocational guidance research in Great Britain has strengthened this belief in the value of a sound psychological study of each individual. But the methods of necessity adopted in an investigation of limited duration may not prove to be those most suitable for practical day-to-day advising. In the London Experiment carried out by the National Institute of Industrial Psychology, the complete psychological examination was given within a few days (or weeks at most), so that the results represented a sort of "cross section" of the individual taken prior to his fourteenth birthday. The diagnostic value of these measures depended, not only upon the extent to which they truly represented the psychological make-up of the individual, but also upon the extent to which this make-up remains characteristic of him during his occupational life. Apart altogether from the validity and reliability of the methods of examination employed, there were therefore two important sources of error: the first was the possibility that the individual's variations in performance were so great that no "picture" of him of any value for diagnostic purposes could be obtained; the second, the possibility that even if the "picture" obtained at the age of 14 were a true one it might bear little resemblance to that which expresses the individual at the age of 16, 18, or 20.

In the London Experiment follow-up studies of the industrial history of the boys and girls examined extended over four years. Not a very long time perhaps, but long enough to give useful data.[2] In spite of the great complexity of the investigation and the many conflicting issues involved, it was shown quite convincingly that there is a definite association between psychological make-up and vocational success, both in the experimental group and in the control group. This latter group consisted of boys and girls of the same age (14) leaving from the same schools at the same dates. But whereas in the control group the individual's make-up had to be guessed from his school marks and from teachers' reports, in the experimental group it was based upon a comprehensive psychological examination in which marks and reports played a minor part. The superiority of the advising of the experimental group was clearly demonstrated.[3]

In a similar experiment in Birmingham a year or two later the same general procedure was followed, and even more

[2] Incidentally, only those who have tried to follow up continuously over a period of years one thousand or so "strangers" (who have no personal interest in the inquiry) can appreciate the labor involved.

[3] *Methods of Choosing a Career*, F. M. Earle and others. London, Harrap and Company, 1931.

striking evidence of its value was obtained.[4] No reasonable person can now be in doubt—if he ever was—that abilities and character qualities shown by an individual in his youth have a powerful influence on his later success, and that these can be measured with sufficient accuracy for predictive purposes. Where constructive criticism should now be applied is towards the improvement of the examination procedure.

In both these investigations the final recommendations as to the choice of an occupation were the outcome of a survey of the child's general physical, mental, and temperamental condition as determined by his school marks, by performances in special tests, and by oral interviews. The London Experiment showed that children of even the poorest classes of city workers could be successfully advised, though the specific value of each part of the total procedure was not directly ascertainable. The Birmingham Experiment suggested that the *special* psychological examination may be shortened without loss whenever more trustworthy school records can be obtained and whenever the advisory work can be made an integral part of the school life.

But neither experiment could deal with the further question of the adequacy of one single "cross section" of the individual. Is it sufficient to judge the individual as he is at 14, or 15, or 16? Or is it better to study him during growth from infancy? If so, at what stage should the definitely vocational problems be seriously considered?

These questions can only be answered by research in which special studies are made at different stages of growth, but this is obviously a task that should occupy many minds for many years. One such experiment, in which psychological studies began at the age of 11, was begun in the County of Fife by the National Institute of Industrial Psychology five years ago and a report of the results is expected some time this year. Meanwhile we may contemplate with some satisfaction the fact that the issues are now considerably clearer than they were. We are no longer hypnotized by the compilers of "intelligence" tests into the belief that they all measure the same abilities, or that a "general ability" test will be of any diagnostic value in a situation in which specific abilities predominate. We do not expect that a test which gives a reliable measure of an ability at one age or with one sex, will necessarily be of equal value at another age or with the other sex. We know or we suspect that some tests (Performance Tests, for instance) are likely to be better measures of "general ability" at one age than at another; that other tests (Mechanical Ability, for example) are more useful for boys than for girls. Facts like these emphasize the grave dangers that lie in a guidance procedure which employs a very limited psychological examination and which fails to discriminate between the responses of individuals of different sex, age, and training. But they also show that we have advanced in our conception of what vocational guidance means.

IV

Development in the future undoubtedly requires the elucidation of a number of doubtful points concerning the changes in the abilities of an individual from age to age, the differentiation between specific and general abilities, the minimum qualifications for particular kinds of work, and the like. Then there is the place of the

[4] *The Value of Vocational Tests as Aids to Choice of Employment*, E. P. Allen and P. Smith. Birmingham, Education Committee, 1932.

school record and how it can be improved. Systematic school records will show what has happened from stage to stage, and while it is important to know what the boy or girl is *now*, it may be equally valuable to know how he *came to be* as he is. Especially is this so in abnormal cases. It is not difficult to envisage a time when a diagnostic examination of some special ability may be given at a particular stage in the child's development as a clue to the next step, and from a series of such examinations over a period of years, combined into one comprehensive and systematic psychological survey, to formulate a vocational recommendation of the highest significance and value to the individual concerned.

It follows, therefore, that psychological examinations that are worth while cannot be successfully introduced into the study of individual human beings by any person who imagines they will be useful short cuts. The student of human behavior must be trained and experienced, though this does not necessarily mean that he must be a highly skilled psychologist. A person who brings interest and sympathy into his relations with human beings and who possesses the ability to comprehend all the issues involved, can readily be trained to carry out this kind of work.[5]

Needless to say, it is to be hoped that everyone who attempts vocational advising will be thus qualified. It is not necessary to have a detailed knowledge of statistical techniques and the elaborate procedures of the research worker. Nor is it necessary to procure highly elaborate or expensive apparatus and equipment. Much valuable work can be done in a quiet and modest way by an intelligent and systematic use of those sources of information which are very often neglected because they are so familiar, viz., the day-to-day activities of the individual. Properly recorded and interpreted, and supplemented by observations obtained in situations specially devised to throw light upon particular aspects, the peculiarly *personal* activities of the individual form the best and safest foundation for offering advice.

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[5] See "The Training of Teachers in Psychological Testing, by E. P. Hunt and P. Smith, in *The Human Factor*, January, 1934, Vol. VIII, No. 1.

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RESEARCH IN GUIDANCE

A Theoretical Basis

WILLIAM P. ALEXANDER

During the past year the writer has traveled over much ground in the United States of America. In so doing he had the privilege of intimate contact with many eminent men in the fields of Education and Psychology. To make individual acknowledgment of the inspiration he received from such contacts is not only difficult but impossible. Each of them stimulated the writer in his thinking from a different point of view, each contributed in some way to the formulation which is made in this paper. Perhaps he may fairly say that what he writes here is a synthesis of the ideas with which he landed on these shores and those he encountered as he made his way from the Atlantic seaboard to the Pacific. His thanks are due therefore to many, and he would make grateful acknowledgment of his debt. In particular he would express his thanks to Professor Thorndike of Columbia, Professor Kelley of Harvard, Professor Thurstone of Chicago, and to Professor Charles Spearman. He would add a special note of thanks to various audiences who listened to addresses on this subject and from whose criticisms and suggestions much was gained. This especially holds for the members of the Conference on Guidance held at Stanford University in the summer of 1933.

W. P. A.

London, December, 1933

IN SUGGESTING a theoretical basis for research in guidance there are several fundamental points which must be discussed as a preliminary to the setting out of the theory.

In the first place we had better make clear what we mean by guidance and what different fields of research must be included in a guidance program.

In the second place we should do well to examine the basis on which guidance rests at present, indicating in what respects we consider that to be inadequate and where we hope to increase the value of that basis. This must involve some discussion, however brief, of existing theories and of previous researches. We cannot discuss these at all adequately in such a short paper, but by selecting points of view as representative as possible, we may be able to clear the path for the presentation of the suggested theory so as to place it against the background from which it has sprung. We hope that it will be appreciated that our discussion of previous work and existing theories is not intended to be exhaustive. It will not attempt to evaluate all work done nor even the important work in all fields. We shall simply suggest the principal lines of thought that we see to underlie present work in the field.

Our purpose may be defined as the presentation of a suggested theory for research in guidance, not as proved, but rather as worth proving.

II

What Is Guidance?

Guidance, as we see it, is dependent for its success on three fields of investigation. First, it depends on a knowledge of the individual; second, on a knowledge of the situation in which the individual is to function; and third, on the techniques by which we bring these two spheres of knowledge together. The first of these is the field of educational and vocational psychology, the second is the field of industrial and educational sociology, the third is the field of guidance, both educational and vocational. The essential purpose in guidance is to make the individual aware of himself, and also aware of the situations in which he could function fully, could realize himself to the greatest degree, and live both happily and successfully.

To be successful in guidance, then, we must have adequate research in all three fields. If our individual analysis is incomplete, if our occupational analysis is incomplete, or if our techniques are inadequate we can succeed only partially. Advance must therefore take place along a coordinated front. Good guidance means good individual analysis, good occupational analysis, and good guidance technique. The realization of the interdependence of these three fields is fundamental.

Now it will be clear that if there is to be close integration of the different fields of research it is of vital importance that we shall use *the same set of terms* in each field. If we conduct our individual analysis in one set of terms and our occupational analysis in another set of terms, the work of fitting these two together is nearly hopeless. This is a point in which I suggest we have failed until now. Too often occupational research deals in terms which either have a different connotation when used in individual analysis, or else are absent from individual analysis altogether. To know that a person has certain ratings in A, B, and C is little help if we only know the needs of the situation in terms of ratings in D, E, and F. It seems an obvious point, too obvious to need stress, yet it is too often disregarded.

Our requirements in guidance may then be set out briefly as these: A complete and accurate individual analysis in a definite set of terms, a complete occupational analysis in the *same* set of terms, and as perfect guidance techniques as can be attained. Such an aim seems almost impossible of achievement and perhaps it is so. As we approach most nearly to that aim we shall fulfil the needs of guidance. The purpose of this paper is essentially to suggest a set of terms which, were research based on them, would, in our opinion, lead to a greater realization of this aim than we have yet achieved.

III

The Present Basis for Guidance

I should almost certainly have made this heading in terms of bases rather than basis. It would appear that there are several bases for guidance suggested. By basis I mean really the set of terms which are to be used, for obviously, that is the fundamental issue.

Let us look for a moment at the problem of individual analysis. It appears that there is basic disagreement among eminent psychologists as to the nature of the unities in which such an analysis should be made. Keeping within the sphere of abilities we can find at least three positions held. There is first the theory of Spearman[1] which lays stress on the fact that in this sphere there is one

[1] *Abilities of Man*, C. Spearman. Macmillan, New York, 1928.

general factor which he calls "*g*," and a large number of specific factors each of them independent of the others, and all of them independent of "*g*." On this basis we shall consider principally measurements of "*g*," and according to the individual's rating in "*g*" we place him in that situation in which such a rating in "*g*" is necessary. As a part of any basis for guidance this is obviously necessary, since what we are saying really is that general intelligence is an important factor in guidance. That it is so is admitted everywhere. However there is really a fundamental problem involved here because there are many equally eminent psychologists who disagree with this fundamental point in Spearman's theory. For example, there is the attitude of a whole school of psychologists—Thorndike, Paterson, Toops, Hull, Kelley and many others—who have suggested what they describe as the theory of unique traits. This theory describes abilities in terms of a limited number of largely independent traits, but has no place for a quite general factor such as is indicated by Spearman. Their unique traits do in fact overlap somewhat, showing that there is something in common between any two of them, but in so far as the amount in common is small they can be fairly described as largely independent. It is claimed that this theory "not only simplifies and clarifies the assumptions underlying much of the work of testing, but makes the specifications of the task definite and introduces order into the practical procedure."[2]

It is true that it is intended to do so, but it will be suggested that it must fail unless the unique traits are *quite* independent. That this is so can easily be shown and is in our opinion a fundamental point for research in guidance. If these traits are not quite independent then it follows that the measures of them are measures of composite things, not of *unitary* things. As such the scores on these measures may be utterly misleading in many cases.

Let me take as an example one with which all my readers will be familiar. We use as a measure of "General Intelligence" verbal group scales such as the Otis, the Terman, and so on. Now such a measure meets the requirements of the unique trait school quite admirably. To quote from that workmanlike book from Minnesota on mechanical ability tests—"positive correlations with the criterion will tell what the trait is; low correlations with other traits show that it has been successfully disentangled from its unnecessary concomitants."[3] There is the criterion. Let us now go back to such a test. It will probably be admitted that a sound criterion for general intelligence is progress in school work taken generally. With such a criterion our "Verbal Scale" will have a correlation coefficient in the region of .6 probably, and therefore shows a satisfactory agreement with the criterion; on the other hand, it will show a low correlation with other traits as, for example, the trait of mechanical ability as defined and measured by the Minnesota Test battery. We may find in this case a correlation as low as $r = .1$ or .2. In fact, these are approximate correlations to be found in the Minnesota data.[4] It must be assumed by such workers then that our "Verbal Scale" is an adequate measure of general intelligence. In our opinion that is fundamentally wrong for guidance progress. Why? Here is the reason. It can be shown clearly that a

[2] *Minnesota Mechanical Ability Tests*, Paterson, Elliott, Toops, *et al.* Univ. of Minnesota Press, Minneapolis, 1930. p. 14.

[3] *Op. cit*, p. 15.

[4] *Op. cit*, p. 246 and p. 247.

test such as the "Verbal Scale" does not measure *one* thing, it measures a composite of two factors or traits. In this particular case we find that it is just this fact that leads to so much difficulty. Let us try to make this point clear. We argue that in guidance a test must measure *one* thing. We suggest that this is possible, and we indicate later a theory on which research would yield such measures. This is imperative because otherwise we shall not be able to tell how much of the score in the test is attributable to the different factors playing a part in the composite. Suppose, for example, we use a measure such as this and get two men with equal scores in the test. That may not mean they have the same "general intelligence." One may have more than the other, but the verbal factor which also plays a part in the test has allowed the compensation in the total score to take place.

This point will come up later and will be made quite clear when we set out the factors as we see them to exist and discuss the relationship between *functional abilities* and *psychological factors*. Meantime let us continue with our discussion of existing bases.

While we have included Hull and Thorndike as supporters of the theory of unique traits as sponsored by the Minnesota school, we feel that Hull[5] especially is perhaps a greater specifist than the others. He appears to cling to the belief that aptitudes are particular, not in any way general. As we see it, this is due to the fact that Hull is thinking of functional aptitudes and not of psychological factors. The distinction which this implies will be discussed in greater detail later. It must be borne in mind that Thorndike, who is the father of this whole school, started with the specific theory. He moved towards a trait theory, at least for practical purposes of testing. In 1920[6] we find him suggesting that there are three broad spheres of ability which we must consider. These he called Practical Intelligence, Verbal Intelligence, and Social Intelligence. Again it seems to us that while this is sound functionally, there is real danger of us being misled if we do not recognize that each of these is a composite, not a unity. They are not distinct abilities. Each has much in common with the others. We explain that later, but perhaps we may anticipate and suggest that Practical ability is a composite of two factors *"g"* and P, Verbal ability is a composite of two factors *"g"* and V, and Social ability is a composite of *"g"* with certain S factors. In each case the *"g"* we use is the same. The definition of these factors is contained in the description of our theory, so we will leave the matter there. We are stressing really a difference which is rather fundamental, *viz.*, the difference between functional abilities and psychological factors. The *abilities* are syntheses of the *factors*. If we adopt the abilities as unitary traits for measurement we are measuring composites and will meet the difficulty we have already stressed. Let me illustrate what this means once more before we go further. Suppose we accept the concept of verbal ability and set up a measure of it. Now we go to some occupation to find the requirements in this ability. Let us take policemen. We find that a score of 100 in such a test is necessary for policemen. We select an individual, "A," who scores 100 and suggest that he be a policeman. (There are many other things involved, but we are allowing them to be considered as suitable meantime for simplicity.) The individual, "A," fails

[5] *Aptitude Testing*, Clark L. Hull. World Book Co., New York, 1928.

[6] "Measuring Human Intelligence," E. L. Thorndike. *Harpers Magazine*, January, 1920.

as a policeman. Why? Because the test is measuring a composite, it may be that the policeman we tested scored 100 due to 80 points from *"g"* and 20 from V. Our individual, "A," scored 100 due, however, to 60 points from *"g"* and 40 from V. Now it may well be that V is of little importance to policemen and what is needed is really a minimum of 80 points of *"g."* Our individual, "A," fails because he has only 60 points of *"g."* We were not able to tell that because we were using a composite measure.

It is for that reason that we cannot be content to accept the point of view of Hull or of Thorndike. Yet it is true that *functionally* we are thoroughly justified in speaking of such abilities. We must not measure abilities and only these, *we must measure factors,* which have unity in a different sense. In the sphere of personality there is need for greater advance than in the sphere of abilities. We have had many tests of various personality traits (using that phrase functionally) which have been more or less helpful. In every case there is the same problem that we have stressed in the sphere of abilities, *viz.,* the problem arising from the use of composite measures. We have measures of Fair-mindedness, of Dominance, of Excitability, and so on. These are certainly all composites. They result from certain syntheses or combinations of certain personality factors. These factors we discuss later.

Perhaps no better work has been done in this sphere than that of Cattell.[7] Here we have an attempt to find the factors in personality. In producing tests American psychologists have gone far. The Bernreuter[8] test is an excellent example.

As for having a theoretical basis underlying the preparation of such tests, there is none. As is said in *Minnesota Mechanical Ability Tests* already referred to, "Most often there is not even an indirect reference to the possibility of measuring human personality in all its aspects." Later we find a criticism regarding "vague references to the important role of intangible character qualities." The Minnesota group recognized the needs of this sphere. They are great indeed. In our theory we include the whole of human personality, and we believe that in so doing we open up very great possibilities for guidance.

Speaking very generally, then, we may say that the basis on which guidance rests at the moment is largely confined to certain traits in the ability sphere and that these are not measured successfully because there are in use only composite measures. Further we have to recognize a difference in the recognition of a general factor as most vitally important by Spearman in contrast to the absence of a general factor in the theory of unique traits, held by Thorndike, Paterson, Toops, Hull, and Kelley. No discussion of this sphere of work, however brief, can omit a special reference to the work of Kelley. He has made very notable contributions to the field, and we believe his book *Crossroads in the Mind of Man*[9] to be perhaps the most exhaustive discussion of the problems we have read. Apart from Spearman's *Abilities of Man* we can find no discussion of such value. In that book Kelley seems to reach a position essentially similar to that of Hull, Toops and the others of the unique traits group except that he has, in our opinion, a much better statistical basis for his conclusions than is given in the Minnesota work.

[7] *British Journal of Psychology,* Vol. XXIV, 1933. "Temperament Tests, II Tests," R. B. Cattell.

[8] *Personality Inventory,* R. G. Bernreuter. Stanford University Press, 1930.

[9] *Crossroads in the Mind of Man,* T. L. Kelley, Stanford University Press, 1928.

He is very definitely concerned with unitary traits and his method of assessing these is statistically valid. He, too, cannot find place for a general factor, but here we have a different argument and probably a more valid one. The argument takes the form that the general factor is dependent on the particular set of tests used in establishing it. In the earlier stages of Spearman's work we believe that argument to have had complete validity. Today we consider that difficulty can be overcome. It is true that, unless the number of cases is very large, tetrad analysis (as used and defined by Spearman) may fail to reveal a group factor and thus make *"g"* dependent on the tests used. For example, Spearman found only that general factor in verbal intelligence tests at one stage. Later, however, Stephenson[10] working under Spearman, found that such verbal tests did not satisfy the criterion with large numbers, that in fact such tests were a measure of two factors (apart from specific factors) which could be called *"g,"* the general factor, and V, the verbal factor. On the other hand, they found that they had in their perceptual tests a measure which correlated to the remarkable extent of .99 with *"g"* and had no other factor present at all. In fact they had discovered a true measure of *"g"* and of *"g"* only. Now here is an important point. If we allowed *"g"* to be defined as "that factor measured by this perceptual test battery," obviously since this is a measure of a *single* thing, *"g"* would remain constant. It is the case that such a procedure would be thoroughly practicable and would undoubtedly mean a constant general factor and a measure that would concern only *one* factor. That we suggest is the basis of our procedure. Further we suggest that argument as to whether there is a general factor is wholly unnecessary. Surely, as Thurstone says, the fact that we cannot get any pair of tests that are likely to be measuring intelligence to correlate negatively is ample proof that there is such overlap as *can* be interpreted as belonging to one factor. At the functional level it *is* one factor no matter how it may be otherwise interpreted.

In a word, we suggest that the differences in the existing theories are resolvable and that the essential truths contained in all of them will be found in the theory we here outline. We find room for a general factor defined as a statistical entity and measured best by perceptual tests such as have been used by Spearman and Stephenson.[11] We also find room and evidence for the existence of several group factors or unique traits and further, and most important, we suggest a theory as to the number of factors involved in personality and the explanation of interests which are so much dealt with in the work of Professor Strong.[12] In fact, we presume not so much to offer a new theory as rather to restate existing theories with an extension to the field of personality inspired by contact with Professor Thurstone. Our emphasis on personality is, we consider, vitally important. As we see it, much of the difficulty in securing tests in this sphere is removed by the presentation of the methods of analysis in "Multiple Factor Theory" by Thurstone.[13] We shall not be free to discuss the question of method, but by adding an appendix indicating the type of evidence

[10] "Tetrad Differences for Non-Verbal Tests," W. Stephenson. *Journal of Educational Psychology*, Vol. XXII, 1931.

[11] We understand that Spearman will publish very shortly such a test under title *Visual Perception Tests.*

[12] *Manual for Vocational Interest Blank*, E. K. Strong, Jr. Stanford University Press, 1933.

[13] *Multiple Factor Theory*, L. L. Thurstone. Edwards Brothers, Ann Arbor, Mich., 1933.

on which the theory is based and the road along which the complete solution will be found we hope to indicate where its strength seems to us to lie.

Let us summarize what has been said here before we outline our theory. We have stressed the need for integration of the research work in different fields. We have stressed the need for using *one set of terms*. We have stressed the need for using terms which are unitary and measures which assess one trait or factor. We have briefly indicated our belief that this can be done through multiple factor analysis[14] and, probably, the use of tetrad analysis in conjunction therewith. We have suggested that we must hold our terms or factors constant by defining them in statistical terms and validating measures of them after the fashion of the perceptual tests of Spearman and Stephenson. Now we proceed to the task of setting out the theory on which we believe guidance should rest and in which we might have a complete picture of human personality and ability such as is really needed but which seems so hopeless of attainment.

IV

Hierarchical Theory

We choose the name hierarchical theory to indicate that it is not monarchic, having one general factor and the rest quite subordinate; nor anarchic, in the sense of having a very large number of factors of more or less narrow nature; nor again oligarchic, in the sense of having a limited number of factors of more or less equal importance; but rather hierarchic, since it has one general factor and moves from there through an increasing number of factors of less breadth to the large number of specifics of special interest in one reaction only.

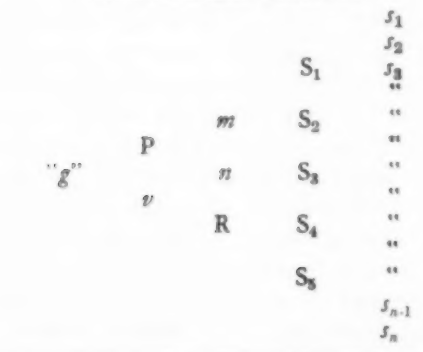
Our basic conception is that the abilities and personality traits of man are *functional* unities at different levels. Thus in the last analysis "I" am a unity. Further we see that all such functional unities as abilities and personality traits and interests and so on are resolvable into a limited number of psychological factors as defined by statistical analysis, and that these factors are single entities in a new sense since they are not resolvable by statistical analysis but are the *units* which synthesize or combine to form all *functional* abilities, interests, and so on. Further we consider that these factors can be represented as hierarchical in arrangement varying from the one factor "*g*" which plays a part in all cognitive experience to the large number of specific factors which play a part in only one such experience. All these factors are independent of one another and of "*g*" and in terms of them *all* abilities, personality traits, and interests can be explained. Between the general factor and the specific factors are factors which vary in their breadth, and according to their breadth they find their place in the hierarchy. By breadth we mean the number of life situations in which they play some part. We realize that the importance of a factor in different situations may vary greatly. Thus in one situation "*g*," for example, may be quite the most important factor present, whereas in another it may play a very minor rôle compared to certain other factors.

This conception may be represented diagrammatically as shown on page 82.

It should be noted at this point that the placing of these factors in this diagram is purely tentative. Further research must decide their placement according to their breadth. Here we are concerned to illus-

[14] See footnote 13, also *A Simplified Multiple Factor Method*, L. L. Thurstone. University of Chicago Bookstore, 1933.

HIERARCHICAL DIAGRAM



trate the basic concept rather than to place absolutely those factors for the existence of which there is already evidence. (The work of the Differential Traits Committee will be a very great contribution to the completion of such a diagram as we are here suggesting.)

In the diagram the factors are grouped horizontally according to their breadth. Thus a broad factor playing a part in many life situations will be found near the apex of the hierarchy while on the extreme side we find the specific factors which play a part in only one situation.

At this stage we may make clear certain distinctions in terminology which are important. By *factor* we mean an entity defined statistically and being one of the factors in our hierarchy. Factors are therefore not functional but are statistical entities having a psychological significance. We use the term *ability* only in a functional sense. Thus we speak of mathematical ability meaning that synthesis of *factors* which functions to enable a person to do well in the study of mathematics. Abilities are therefore always composite. *Practical ability* means the functional ability that leads to success in the world of things. *The practical factor* means that factor in our hierarchy which *along with* "g" and maybe other factors functions as practical ability. Or again verbal ability will be functional ability that makes for success in school work. The verbal factor will be that factor which along with "g" and maybe other factors functions as verbal ability. We must note therefore that when we say ability we refer to a functional thing which is always a synthesis of two or more factors. The factors are the psychological unities.

By *breadth* we mean the number of life situations in which a factor plays some part (whether more or less important). In fact, the importance of a factor varies from one situation to another, but as long as it is playing some part in a situation it ranks as being present. The broadest factor is "g" of course, while *s* factors are the narrowest.

Now let us examine the diagram and indicate, at least tentatively, the significance we attach to these letters. In accordance with the concept of breadth we have arranged the factors in a hierarchy. On the left we find "g," which we may call the *general* factor, as the broadest factor of all. It is so placed because we find that it plays a part in all cognitive experience—sometimes, indeed often, a most important part, sometimes less important, but always it is there.

The symbol *v* follows and represents the verbal factor. This factor is independent of "g" and *along with* "g" functions as what we may call *verbal ability* (a functional ability). It is this ability we appear to have been measuring with our usual verbal scales of intelligence, and it is just because we have been measuring this *functional ability* comprising a composite of two *factors, viz.*, "g" and *v*, that the problem referred to above in terms of composite measures has been so marked. For example, it is a recognized thing that the use of such verbal scales

has been much more successful in school guidance than, say, in vocational guidance. The reason is simply that whereas school ability is dependent on *both* factors involved in the test, in many cases vocational success is dependent only on one and not on the other and so our composite measure is inadequate.

P is placed alongside *v* for breadth and represents what we may call the practical factor, P is independent of *"g"* and *along with "g"* functions as practical *ability,* the ability which makes for success in the practical world, the sphere of things rather than of words or symbols. Notice again that our measures, such as performance tests of intelligence, are measuring composites, in this case *"g"* and P, and again will cause us to be faced with the problem already referred to. It is to be noted that until now research directed to establishing the existence of a unique factor common to performance tests has been inconclusive.

The writer has evidence which establishes the existence of this P factor. This evidence cannot be included here, indeed no evidence is being included because of the nature of this paper, but it is hoped that all such evidence will be in published form sometime in the fall of 1934. Our concern here is with the interpretation of that type of evidence.

The letters *m, n,* R are used to represent factors which we may call respectively, mechanical factor, number factor, and reasoning factor. These are probably of less breadth than P and *v* and are therefore placed as shown in the diagram.

Before going over the S factors which are perhaps the most important part of this theory, let us run over those factors which are already described and indicate references in literature. The *"g"* factor is, of course, that established by Professor Spearman and over which there has been so much controversy. Indeed in his book, *The Abilities of Man,* Spearman cites several group factors which have since been established. It is to be noted that whereas *"g"* as defined initially by Spearman was said to be measured by verbal scales as a single entity, it is not, in terms of the true definition, measured *alone,* but in synthesis with *v,* in verbal tests. Perceptual tests such as used by Stephenson and Spearman are the best measure of *"g."* Verbal scales measure *"g"* and *v* together. It is just because this is so that we find the difficulty noted above.

The factor *v* emerged from the work of Stephenson[15] conducted under the guidance of Spearman. It was also established independently by Kelley.

The P factor has emerged from the work of the writer and his evidence for that will be published later in 1934. In the appendix will be found one sample of evidence.

The factor *m* representing mechanical ability has been established by Cox[16] using a tetrad approach and again essentially by Paterson, Toops and others[17] at Minnesota in their mechanical abilities work there. The Minnesota results indicate more than one factor in this sphere.

The *n* factor will be found referred to in Kelley's *Crossroads.*[18] Again Kelley, like Spearman, has indicated and shown evidence for several factors. But as before we may need to define these factors according to the analysis we make, so that they shall not be dependent on the tests used but rather that the tests devised at any time will be shown to measure cer-

[15] "Tetrad Differences for Verbal Subtests Relative to Non-verbal Subtests," W. Stephenson. *Journal of Educational Psychology,* Vol. XXII, 1931.

[16] *Mechanical Aptitude, Its Existence, Nature and Measurement,* J. W. Cox. Methuen, London, 1928.

[17] See footnote 2.

[18] See footnote 9.

tain combinations of the factors already defined. Of this more will be said later. The R factor has recently been shown to have existence by Murdoch[19] working in London.

The factors s_1, s_2, and so on are the specific factors so often referred to, and as such need no source in literature. They are agreed on as existing by all, to the best of my knowledge. We may disagree on their importance, though again it is a matter of the particular situation. They are important in some cases, in others they scarcely matter. Since the possibility of assessing all of them in any one individual is almost hopeless, we must consider the broader factors as more important in general, and watch that our ratings of these are not made invalid by the absence or presence of a specific *s* in a certain situation. Thus according to what we propose to do in a particular case we must measure the specific factor for that situation before saying it is suitable. A boy may have the right amount of *"g"* and *v* and P and all the others to do well in a certain situation but lacking the *s* for that very markedly, he may fail. To cover this we measure that *s* but not all his *s*'s.

Now let us discuss the factors S_1, S_2, S_3, S_4, S_5. These represent five personality factors. Professor Thurstone has tentative evidence that five factors are all we need to explain personality variations. The writer has further evidence that a small number of factors is sufficient. (We do not commit ourselves to five. It may be six or seven, but we take five meantime.) Now that does not mean that there are only five kinds of personality—far from it. By different combinations of different amounts of these factors we get an infinite number of different kinds of personality. But to get any one personality we only need certain loadings of five factors. That is very important. Further and more important, we can and must validate tests in terms of these factors, so that we are again measuring single entities and can load them in proper amounts to get the personality as a whole. This can be done statistically just as Spearman produced a measure of *"g"* which we believe to be quite satisfactory.

I have been asked always when I have lectured on this idea "What are the five S factors?" The answer is that they have to be fixed according to future research. We can make one of them what we wish and immediately two are fixed because they are independent or orthogonal. Let me put it this way. I am suggesting that a man be represented as a point on a five-dimensional spherical surface. His personality will be represented by the radius to this point. The principal axes of the sphere represent the factors and are orthogonal and five in number. Now obviously we may rotate these axes and in so doing will alter the projections of the radius on the axes representing the personality, but we *do not* alter his position in the sphere. Thus we may alter the names of the factors and the loadings of them possessed by this man, but really we have not altered the personality of the man. Now clearly we must, as in the case of the other factors, hold these constant. This can be done by agreeing where it will be best to fix these axes, a matter done on an arbitrary basis with a view to making them best for practical purposes of guidance. Having once fixed them they are held constant, and any new test suggested in the sphere of personality or in any other sphere is studied to see how it correlates with our factors. According to these correlations we can tell what is its best use. Just as we know that a

[19] An unpublished thesis in the University of London Library.

verbal scale such as the Terman Group Test is a measure of "*g*" and *v*, and further that this combination is rather important for school work, though not nearly so important for vocational work in most cases, so we may find that, say, the Bernreuter Test is a measure of S_1 and S_3 and that as such it can be used—always realizing that it is a measure of a composite kind and should be best resolved into its elements. So also with "*g*" and *v*. We have, I suggest, a measure of "*g*" in perceptual tests. We must now set about validating measures of *v* and of P and of *m*, and so on, as far as possible independently of "*g*," and if they are not wholly independent as measures, then we must allow for the effect of "*g*" and find the true measure of *v* or *m* or whatever it is we are wanting to measure. One of the great contributions of the Minnesota work is that it has provided a measure which is undoubtedly a measure of "*g*" and *m* in combination but which is largely saturated with *m*. Allowing for the effect of "*g*" we can get from it a measure of *m* that will probably prove to be thoroughly sound. Not to take account of "*g*" will leave it a composite measure with the same dangers as in the case of verbal scales applied to industrial work.

That is our theory for research in guidance. We have discussed it with Professor Spearman, with Professor Thurstone, and with others. There seems to be a large measure of agreement. Unfortunately for us, we were prevented by time from discussing it with the Minnesota group. We did, however, have an opportunity of discussing it with Terman and a group at Stanford and again found considerable agreement and interest. Most interesting is perhaps the fact that Tryon[20] at Berkeley was sympathetic to it. His work in genetics has made him a very strong opponent of the two-factor theory of Spearman. As I see it, we have a functional system of abilities, interests and so on which can be resolved into a psychological factor hierarchy. It may be that this hierarchy can be resolved into a genetic system of entities and make a still more scientific basis for guidance. The problem is which of these systems is most valuable for guidance work now, and my suggestion is that this system of *psychological factors* is best. To use a system of *functional abilities* is to allow *composite* measures to be used as *unities* in guidance, and that must result in inefficiency.

Let me expand this concept by discussing the interest sphere. It is true that we talk, to take an example, of an "interest in people." Professor Strong indicated such an interest as important in a lecture at the Guidance Conference at Stanford in the summer. I appear to have omitted interest altogether from the scheme of things. That is not so. Interests are, in my opinion, functional. That is to say any interest, such as "interest in people," is the synthesis in the individual of certain *factors* as indicated in our diagram. Perhaps "interest in people" is, say, due to a certain amount of S_1 and S_3 along with "*g*." Let us make this clear. Let us be quite extravagant for a moment. Suppose we find that it is possible to define S_1 as dominance (notice that this assumes dominance to be a unitary psychological factor which may or may not be true—probably it is not true) and in the same way let us suppose we find S_3 may be defined as extraversion. In actual fact, we shall never so define our factors since this is using terms which are in popular use and are ambiguous. Now suppose we find that "interest in people" is due to *high* S_1 and *high* S_3. That is to

[20] "Multiple Factors *vs.* Two Factors as Determiners of Ability," R. C. Tryon. *Psychological Review*, Vol. 39, No. 4.

say "interest in people" *as a functional entity,* is resolvable into so much dominance and so much extraversion which are *psychological factors* S_1 and S_2. When we find high S_1 and high S_2 we know that this person will be interested in people. What about "*g*"? Probably "*g*" determines the level on which this interest in people will find suitable expression. A person with high S_1, high S_2, and high "*g*" may be an excellent professor of education, or teacher, or personnel officer. A person with the same S_1 and S_2 and therefore "interested in people" *but* with low "*g*" may well make a real success as a shop assistant, or some such thing where it can be shown that his "*g*" is enough for success in salesmanship of that kind and where this interest in people is necessary. The hope is that we are going to be able to make virtually an equation for a man and an equation for an occupation *in the same terms,* which will be so complete that guidance may be said to be scientific. These terms we are here suggesting.

Notice that in the discussion of the significance of "*g*" above we have mentioned a vital point in guidance. Interest being functional, it is often indicated by people in terms of specific occupations. Yet it is obviously true that for any interest there are several outlets. When a boy says he wants to be a teacher because he is interested in teaching, he really does not mean that. He probably means that he wants to be a teacher because he is "interested in people." If we find then that his "*g*" is too low for this occupation, we must introduce him to those other spheres where "interest in people" can find suitable expression and which are suitable to his level of "*g*." That is guidance. As the generations pass the ways in which various interests can be expressed change, but the essential nature of the interests does not change because it is dependent on the psychological factors which are in the individual. We are prone, however, to express ourselves not in terms of these true functional interests as "interest in people" or "interest in things," or maybe, "interest in words," but rather as interested in teaching, or interested in engineering, or interested in literature. These are particular spheres of expression of the other interests, and they in turn are due to certain ratings in our psychological factors in the individual, influenced probably by experience.

Briefly, then, that is our theory. Let us just add a word as to how we should like to see research conducted.

V

Future Research

First, we would suggest that to be successful future research must be integrated by some central body. I mean that research in the different fields must be so controlled that all the findings in all the spheres, either individual or occupational, are in *the same terms.* In America the National Occupational Conference looks like the body that must perform that function, while in Britain I look to the National Institute of Industrial Psychology in London to take the same place.

Second, we must conduct one research which shall take in the whole field of abilities and personality *at one time.* This is essential if we are to establish factors which will be independent. To do research in abilities and resolve the factors and then do the same in personality means that the relation between the two sets of factors is unknown and they will inevitably overlap. We seek one research covering the whole of man, at least psychologically. This research kept as a unit and using multiple factor analysis should result in the establishment of a diagram such as we here indicate.

Third, we must validate tests in terms of these factors so that we have measures of single entities. Where we cannot get a measure of a single entity we can hold the one factor entering constant and assess the measurement of the other. Thus to measure *v* we can measure *"g,"* then measure *"g" and v* and then calculate the measurement of *v*. All tests at present in use can then be established as being measures of these factors according to research in terms of them. The extent to which they measure various factors can easily be found, and as such composite measures they will prove very useful in many ways. For example the Bernreuter personality test may prove to be a measure of S_1 and S_3, and as such we may have a definite place for it. Alternatively it may, with suitable alteration, be made a test of one of these. In point of fact all such tests should be included in the original research so that their placement in the scheme of things would be ascertained at the same time as the first task was being fulfilled. The point is that the criterion of what tests measure is in terms of *internal* analysis, and then in terms of the factors we go to outside occupations and needs and find what combination of factors they require. That, of course, is what we do now, only we use *composite traits* instead of *single factors*.

Beyond this lies the occupational analysis in the *terms* thus defined. Here again there are very real problems as to procedure but that is not for discussion here. The essential point in which we are concerned is that they must use the *same terms* as are being used in individual analysis.

There is, of course, much research to be done in terms of individual differences in the factors, age of maturity in them, and so on and so forth. That can all go on as soon as there are measures of them which are satisfactory. Much information in this sphere will be gained in the initial research. It must be said that in the work of the Differential Traits Committee such a research is under way, except that, as far as the writer is aware, the emphasis is almost wholly on abilities; personality, which is so vital in all guidance work, is largely omitted. Even so, the contribution that will come from the work of that committee must be very great and will go far to completing the diagram we are here suggesting.

It is not a task that will ever reach completion because there must ever be changes in the needs of society. We can, however, hold constant the terms in which we make analysis—and that is to me the most vital point of all. In occupational analysis we will inevitably find the needs changing with change of time and further advance in the technical sphere. We need therefore continuous research work to be carried on, but we can always use the same terms. An engineer may need very different factor patterns from those an engineer needed twenty years ago, but in both cases the needs can be described in the *same* terms. These terms are psychological factors such as we here define.

The work of guidance is a noble work. It attempts to give to all the possibility of full self-realization. As such there is no more worthy service in any nation. The prospect of doing that work on a scientific basis, so that it would be highly accurate in its predictions, makes one almost giddy with the possibilities of happiness that are involved. To have no more square pegs in round holes, either in the matter of work or of living, is an ideal that should send us to our task with a will that must carry us on to success.

We have done much already. We have made progress that is everywhere receiv-

ing favorable comment. This we have achieved with composite measures and lack of integration. What might we not achieve using single measures and with complete integration?

It is in the belief that this theory opens up greater possibilities of greater success than we have yet achieved that it is presented. It is not given out as something new so much as an integration of what has been there before. It is perhaps fairest to describe it as a synthesis of ideas, ideas held by the writer when he arrived on these shores, ideas coming to him everywhere as he traveled in this most hospitable and generous country.

APPENDIX

In accordance with references made in the preceding paper we give in this appendix an example of data analyzed by the statistical method outlined by Thurstone in his "Multiple Factor Theory."

We do not propose to give the details of this analysis since this would involve considerable statistical information which has no place here. We give rather the results of the analysis to indicate what is revealed by such a procedure. We have selected this example because it uses measures with which the readers will be familiar. It should be made clear that the battery of tests used here is not necessarily a good battery for guidance. It is selected in this case to exhibit certain factors clearly, *not* as a basis on which guidance is to be given. What would be a sound battery of tests for guidance is not under discussion in this appendix.

We shall indicate the tests used in the first place, then indicate the results of the analysis in terms of correlation figures, and, finally, by means of discussion of a diagrammatic representation of these data, we shall endeavour to illustrate what is the procedure we suggest for the establishment of the theory we have outlined.

The following analysis was undertaken for the author by Professor Thurstone while the writer was in Chicago, and the interpretation of the analysis was made in the closest contact with Thurstone. Our thanks are due to him for his generosity in placing without restriction the facilities of his department at our disposal and for his unfailing courtesy at all times. From the many discussions which we had with him our thinking in this sphere was cleared and informed as it had never been before.

The following list of tests used in this investigation covers a broad sampling of tests in certain spheres. There is stress especially on those of performance testing of intelligence and verbal testing of intelligence. Here is the list:—

1. The Stanford-Binet Individual Test
2. Otis Group Scale for Intelligence
3. Otis Self-administering Test of Intelligence
4. Terman Group Test of Intelligence
5. Thorndike Scale for Measuring Reading Age
6. Alexander Performance Scale for Intelligence
7. Pintner-Paterson Performance Scale for Intelligence
8. Porteous Maze Test
9. Healy Puzzle II, a Performance Test of Intelligence

It is the fact that all these measures are in use as measurements of intelligence and that on them guidance is based in different places. Some of them are individual in form, others are of group form. Some are verbal in nature, some are practical in nature.

We gave these tests to a group of 80 adults. This allows us to consider the data as coming from a constant age group, since all the evidence is that such measures are independent of age at adult level.

From the scores in these tests we can

calculate a table of intercorrelations. Having this table of correlations, we can apply a process of multiple factor analysis to ascertain how many factors of an independent nature are involved, and further what the correlation is between each test and each factor. This we have done and we record below the correlations.

We find there are two independent factors which we will call I and II respectively. The correlations between each test and each factor are as follows.

Test	*Factor* I	*Factor* II
1	.853	—.157
2	.850	—.274
3	.872	—.344
4	.889	—.380
5	.737	—.414
6	.686	.387
7	.645	.403
8	.486	.467
9	.522	.259

Our interpretation of these data is that Factor II really represents a difference between two factors indicated by the negative correlations and the positive, and for greater facility in explaining our purposes we propose to call the plus aspect of Factor II as defined by the analysis Factor II, and call the negative aspect of that factor in the analysis Factor III. We will represent the data graphically in two dimensions, showing in the diagram the relation established by the analysis. (We would note here that this problem involving the difference factors is one in which we have yet to reach agreement. Had we used a tetrad approach, as we are doing with certain other data, we would establish the three factors as we wish to indicate them. That raises questions of the interpretation of such multiple factor processes which we leave meantime.[21])

Thus we will list anew the correlations produced by the analysis, this time calling the negative side of II, Factor III. This sets up two systems in this way.

SYSTEM 1

Test	*Factor I*	*Factor II*
6	.686	.387
7	.645	.403
8	.486	.467
9	.522	.259

SYSTEM 2

Test	*Factor I*	*Factor III*
1	.853	.157
2	.850	.274
3	.872	.344
4	.889	.380
5	.737	.414

Now we may examine these results to ascertain what would be appropriate names for these factors. Factor I has positive correlations with every test in the battery and these are all above the value .5. That is to say they rank as high correlations. This factor is the general factor of the battery. Now that does not mean that it is a true *"g."* We should have included in the battery tests of the perceptual nature indicated earlier, and these would have been held as measures of true *"g."* We are satisfied, however, that had we used such tests in this case the *"g"* factor would have had substantially the same results as this general factor. This has come from examination of other data in which such tests were used. Meantime let us realize that we should have used such perceptual tests and located the *"g"* axis in the centroid of such a system. Assuming that this had been done, Factor I would properly be called *"g."* As it is, we will call it the general factor (adding, *of this system,* to be quite accurate).

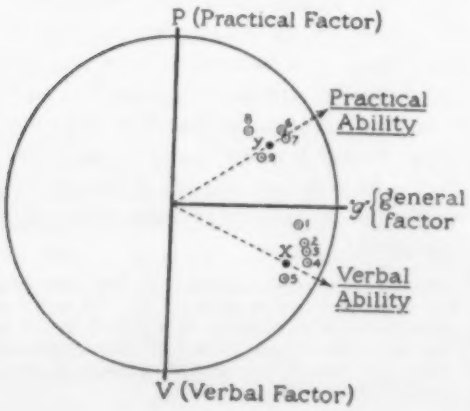
[21] Since the above has been written we find that by rotation of axes this difficulty is completely overcome and that there is absolutely no difference between this set of results so obtained and that obtained from tetrad analysis. We find these data are to be explained in terms of *"g," "v,"* and P—all three being independent factors as indicated in the text of this paper. This analysis complete and with axes rotated is at present in course of preparation for publication.

Let us look at Factor III next as being most interesting and instructive as to procedure in naming factors. Factor III has correlation varying from .157 to .414 with five different tests. The test having this factor to least extent among the five, is test 1, the Stanford Binet. Tests 2, 3, and 4 have Factor III in almost the same amounts and that somewhat higher than test 1, while test 5 is highest in terms of Factor III. Now we know that the Stanford Binet is less verbal than the three verbal Group scales, while they in turn are not quite so purely verbal as Thorndike Reading Age. That being so, it would appear that Factor III increases as verbality of test increases. From such reasoning we decide with excellent grounds to call Factor III the Verbal factor, indicated in our diagram by *v*.

Factor II shows itself as belonging to tests 6, 7, 8 and 9. These are all practical tests, or performance tests. In view of a similar examination of the nature of the tests we call it the practical factor and represent it in our diagram by P.

Now we can represent these results rather advantageously in a diagram as shown below.

DIAGRAM SHOWING RESULTS OF MULTIPLE FACTOR ANALYSIS IN NINE VARIABLES WITH 80 ADULT CASES



Tests as Shown

1. Stanford Binet
2. Otis Group Test (Verbal)
3. Otis S. A. Test (Verbal)
4. Terman Group Test (Verbal)
5. Thorndike Reading Test (Verbal)
6. Alexander Scale (Performance)
7. Pintner-Paterson Scale (Performance)
8. Porteous Maze Test
9. Healy Puzzle II (Performance)

NOTE:—The circle represents correlation of unity along any radius. Thus, for example, the Stanford Binet is placed as shown having correlations or loading of "*g*" of amount .835 and with *v* of amount .157. All the tests are thus placed on the diagram according to their correlation with the factors, a wholly objective process.

It may be noted that the reliability of any test is measured by its distance from the origin. (Note unreliability of tests 8 and 9 relatively.)

The diagram shows along each axis the correlation of each test. Thus test 1 is marked in the diagram as it is because it has .853 of I and .157 of III. And so on with each test. The diagram shows two distinct clusters of tests indicating the presence of two functional abilities and these are marked at points X and Y. This illustrates what we mean when we speak of functional ability as being a combination of two factors. Verbal ability in this case we have taken as the centroid of the system of tests falling in Quadrant I, III. Practical ability we show as a combination of "*g*" and P in Quadrant I, II.

If we had used perceptual tests which are a true measure of "*g*" we should then have placed the "*g*" axis through the centroid of the perceptual system, thus uniquely determining the other two axes.

Notice that Practical *Ability* is *not* independent of Verbal *Ability*. In fact they have according to this result a correlation of .59. That is easily understood when we see that both of them have "*g*" in large amount in common. That is where they are the same. Their difference lies in the

fact that to "*g*," practical ability needs the addition of P, while verbal ability needs the addition of *v*. The relationship of functional *abilities* to psychological *factors* is thus illustrated. This brief appendix must not be taken as in any way an attempt to substantiate the theory we have presented in the preceding pages. It is the merest illustration of the type of approach which seems to illustrate to best purpose what we have been advocating as a sound theory.

WILLIAM P. ALEXANDER received the degrees of B.S., and M.A., from the University of Glasgow in 1928; the degree of C.T., from the Training College at Glasgow in 1929 and that of B.Ed., with first-class honors, in 1931. Mr. Alexander taught at the high school in Paisley, Scotland, during 1929-1930, and was instructor in education at the University of Glasgow during 1930-1931, after which he received a fellowship from the Rockefeller Foundation for graduate work in psychology at Teachers College, Columbia University. The present article, as the author explains in his introduction, is the outcome of his contacts with psychologists during his stay in this country.

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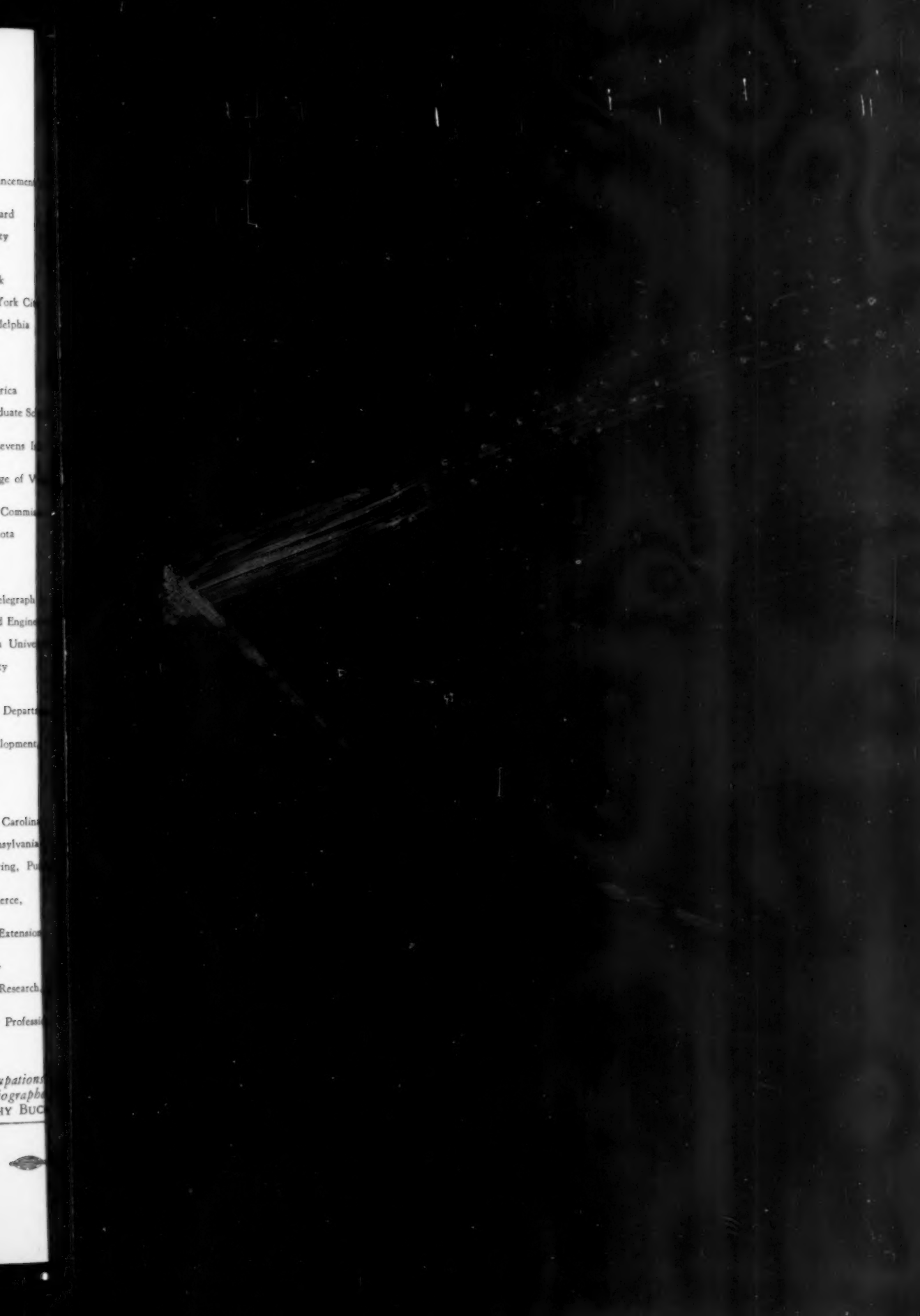
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